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U. S. DEPARTMENT OF COMMERCE
R. P. LAMONT, Secretary
BUREAU OF MINES
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MINERAL RESOURCES
OF THE
UNITED STATES
1927

FRANK J. KATZ
Chief Engineer, Division of Mineral Statistics

PART I—METALS

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MINERAL RESOURCES OF THE UNITED STATES, 1927—PART I

THE MINERAL RESOURCES OF THE UNITED STATES IN 1927[1]

INTRODUCTION

By Frank J. Katz

Chief Engineer, Division of Mineral Statistics

This report, the forty-fifth of an annual series, is published in two parts. Part I contains a general summary of all mineral products, the prefatory note to the chapters on gold, silver, copper, lead, and zinc giving average prices at which values of the metals are calculated, and 27 chapters of which 15 are State or regional reports relating to gold, silver, copper, lead, and zinc mining and 12 are general reports on various metals or metalliferous mineral products. Part II consists of 29 chapters, each relating to one, or a group, of the nonmetallic mineral products, including the mineral fuels—coal, oil, and gas.

The summary which constitutes the first chapter of Part I comprises: (1) General summary tables of production; (2) detailed tables giving data on domestic production and on imports and exports of the various minerals, arranged in alphabetic order, for a series of years, and giving data on consumption, stocks, etc., for some important products; (3) State tables in alphabetic order. Thus, it is a recapitulation of the statistical material contained in both volumes of Mineral Resources of the United States.

Unit of measurement.—The unit of measurement used by the Bureau of Mines for each mineral product in the reports on the mineral resources is that common to the industry concerned, and the variation in these units makes it impracticable, if not impossible, directly to combine and compare the different minerals except as to value, especially because some products are measured by volume, although most are measured by weight.

Elimination of duplication.—In the totals for the United States, shown in the following general tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown, but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production, which is included in the totals. The value of the products of the clay industries is included in both general and State totals as representing the first marketable form of the greater part of the clay produced; the quantity and value of the clay mined and sold in the raw state by miners to manufacturers of clay are shown separately, but the value is not included in the totals.

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[1] In Mineral Resources of the United States the use of leaders (----) indicates that so far as the Bureau of Mines has been able to ascertain there was nothing to report. If data are not available, the fact is indicated by a statement to that effect in a footnote. Leaders are also used in footings where it is quite evident that figures in a column are not addable and in other places where entries are not appropriate.

All figures of imports and exports in this report, unless otherwise stated, were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce, having been converted by Mr. Dorsey to the various units of measurement used in this report and arranged by him in their present form. The imports are those for the calendar year unless otherwise stated. Wherever exports are shown, unless otherwise specified, the figures represent domestic products and not foreign minerals reexported, and they also cover calendar years.

In the general tables both iron ore and pig iron are shown, but the value of the pig iron rather than that of the iron ore is included in the totals, as that is considered the better means of presenting the statistics for iron in its first marketable form. For gold, silver, copper, lead, and zinc the value of "smelter output" is included in the general totals, and in order to account more fully for the value of the ores treated these smelter figures are supplemented by the value of the by-product sulphuric acid. The value of pigments (white lead, red lead, lithopone, litharge, and orange mineral) manufactured from metals is not included in the general tables, as the base from which they are made is included in the output of lead or zinc, whereas the value of sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide is included, as these are made in large part direct from the ores and do not enter into the lead or zinc totals, which represent smelter output.

In the State tables also iron ore and pig iron are both shown. As blast-furnace products can not be distributed according to the States in which the ore is mined, the value of the ore is used in the State totals. For ores of gold, silver, copper, lead, and zinc no values are shown, and in fact none are recorded; instead, for each of these metals the recoverable content of the ores is used as the basis of valuation. The value of the zinc and lead pigments is not included in the State total, as the recoverable zinc and lead content of the ores from which the products were made is included under zinc or lead. The value of the sulphuric acid produced as a by-product of copper and zinc smelting is not included in the State total, as tracing this product back to the State producing the ore has not been possible.

SALIENT FEATURES OF 1927 STATISTICS

The statistics of mineral production in the United States in 1927 show both a diminished rate of output for most of the products and quite general decline in unit values, as compared with 1926. Thus, the total value of all products in 1927 ($5,530,000,000) is 11 per cent less than the corresponding value ($6,213,600,000) for 1926 and 3 per cent less than that for 1925. The year 1925 was one of marked prosperity and high records in output in the mineral industries, but even higher levels of productivity were maintained in 1926. Seemingly the industries producing minerals in the United States and preparing them for use, with a few exceptions, had been speeded up in those years to rates which could not be maintained; consequently slower pace was set in 1927.

The mineral fuels, as a group, show a decrease of about 14 per cent in total value of output. Less bituminous coal and anthracite were produced in 1927 than in 1926, and the total value decreased in somewhat larger ratio. The industry was marked by depression and almost total cessation in some fields for part of the year. Production of the fluid fuels, petroleum and natural gas, increased in amount, mainly because of the development of new pools in Oklahoma and Texas, but the total value of petroleum produced declined markedly.

The aggregate value of output of metals in the United States in 1927 shows a sharp decrease from 1926. Among the major metals, iron (both ore and pig), copper, lead, zinc, silver, and gold shared in this decrease. Only aluminum showed a moderate increase. Metal prices, except for a few minor metals, declined generally. Most striking were the moderate decreases in lead and zinc production despite large price drops. Increases in the production of mercury and of cadmium were noteworthy.

The nonmetallic mineral industries (not including fuels) in 1927, in contrast to the metal and the fuel producing industries, show a moderate decline in value of output. Prices generally were lower and thus offset the increase in quantity of output shown by many of the nonmetallic products. Stone (specifically crushed stone), cement, sand and gravel, and asphalt showed significant gains because of the demand for them by the building and paving industries. Pigment materials, fuller's earth, potassium salts, common salt and its coproducts calcium chloride and bromine, and talc and soapstone also were produced in 1927 in larger amount than in 1926. In contrast to these a number of important industrial minerals and chemical materials—namely, clay, fluorspar, feldspar, glass sand, lime, magnesite, mica, phosphate rock, and silica—showed moderate to marked decreases.

STATISTICAL SUMMARY

By Martha B. Clark

GENERAL TABLES

Mineral products of the United States, 1926 and 1927 [1]

Product	1926		1927	
	Quantity	Value	Quantity	Value
METALLIC				
Aluminum....pounds		$37,583,000		$39,266,000
Antimonial lead [2]....short tons (2,000 pounds)	22,524	3,916,714	24,347	3,277,043
Antimony [3]....do	2,693	856,400	2,736	675,800
Bauxite....long tons (2,240 pounds)	392,250	2,415,200	320,940	1,988,780
Cadmium....pounds	810,428	429,527	1,074,654	645,000
Chromite....long tons	141	2,079	201	5,063
Copper,[4] sales value....pounds	1,739,622,094	243,547,000	1,684,040,983	220,609,000
Ferro-alloys....long tons	689,258	61,368,407	646,749	55,163,574
Gold [5]....troy ounces	2,335,042	48,269,600	2,197,125	45,418,600
Iron:				
Ore [6]....long tons	69,292,832	[6] 174,015,645	61,232,473	[6] 151,125,820
Pig....do	38,181,053	749,633,468	34,866,644	646,226,139
Lead (refined),[4] sales value....short tons	680,685	108,910,000	668,320	84,208,000
Manganese ore (35 per cent or more Mn)....long tons	46,258	1,228,663	44,741	1,151,918
Manganiferous ore (5 to 35 per cent Mn) [7]....long tons	1,217,431	3,138,489	1,461,608	3,947,016
Mercury:				
Metal....flasks (75 pounds net)	7,642	702,323	11,276	1,314,782
Ore....short tons	51,000	(8)	(9)	(8)
Nickel (value at New York City)....do	323	234,558	860	390,740
Ores (crude), tailings, etc.:				
Copper....do	57,636,000	(8)	56,826,000	(8)
Copper-lead and copper-lead-zinc....do	282,000	(8)	419,000	(8)
Dry and siliceous (gold and silver)....do	8,743,000	(8)	8,550,000	(8)
Lead....do	8,358,000	(8)	8,349,000	(8)
Lead-zinc....do	19,093,000	(8)	14,647,000	(8)
Zinc....do	4,139,000	(8)	6,823,000	(8)
Platinum and allied metals (value at New York City)....troy ounces	84,981	9,210,669	46,050	3,780,216
Silver....do	62,718,746	39,136,497	60,434,441	34,266,328
Tin (metallic equivalent)....short tons	8	10,400	27	34,600
Titanium ore:				
Ilmenite....do	(10)	(10)	3,500	44,000
Rutile....do	(10)	(10)	(11)	(11)
Tungsten ore (60 per cent concentrates)....do	1,382	920,400	1,164	724,000
Uranium and vanadium ores....do	21,624	329,000	(11)	(11)
Zinc,[4] sales value....do	611,991	91,799,000	576,960	73,851,000
Total value of metallic products (approximate)		1,402,920,000		1,217,700,000
NONMETALLIC				
Arsenious oxide....short tons	11,805	674,350	11,560	725,360
Asbestos....do	1,358	134,731	2,981	336,882
Asphalt:				
Native....do	715,180	4,484,960	839,040	5,605,850
Oil [6]....do	1,245,160	[6] 15,452,940	1,525,420	[6] 19,019,150
Barite (crude)....do	237,875	1,773,293	254,265	1,670,878
Borates (colemanite and naturally occurring sodium borate)....short tons	115,970	3,128,110	109,080	3,473,399
Bromine....pounds	1,245,760	426,837	1,756,310	564,689
Calcium-magnesium chloride....short tons	82,340	1,710,405	95,721	1,947,797
Cement....barrels (376 pounds net)	164,218,941	280,785,583	174,023,051	281,735,676
Clay:				
Products [12]		430,428,494		403,935,547
Raw [6]....short tons	3,967,198	[6] 14,105,589	3,849,176	[6] 13,697,159

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[1] In this general statement certain of the figures represent shipments rather than quantity mined. The reader is referred to the following sections on the various mineral products for information in greater detail than it seems practicable to give here.

[2] From both domestic and foreign ores.

[3] Figures represent antimony content of antimonial lead. Value excluded from metallic total as the value of the antimony is included in the antimonial lead value. Value for antimony other than that in antimonial lead is included in metallic total; Bureau of Mines not at liberty to publish figures.

[4] Product from domestic ores only.

[5] Value, $20.671834625323 an ounce.

[6] Value not included in total value.

[7] Including ore used for fluxing. For separation see p. A60.

[8] Figures showing values not available.

[9] Figures not available.

[10] Value included in total value of metallic products. Bureau of Mines not at liberty to publish figures. For production in Florida see p. A88.

[11] Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.

[12] Figures obtained through cooperation with Bureau of the Census.

Mineral products of the United States, 1926 and 1927—Continued

Product	1926		1927	
	Quantity	Value	Quantity	Value
Coal:				
Bituminous [13] ... short tons	573, 366, 985	$1,183,412,000	517, 763, 352	$1, 029, 657, 000
Pennsylvania anthracite ... long tons	75, 390, 582	474, 164, 252	71, 513, 896	420, 941, 726
Coke [6] ... short tons	56, 865, 537	[6] 307, 773, 402	51, 092, 143	[6] 262, 320, 578
Diatomite and tripoli ... do	118, 495	1, 605, 173	[14] 26, 099	[14] 447, 068
Emery ... do	386	3, 641	506	5, 855
Feldspar (crude) ... long tons	209, 989	1, 607, 101	202, 497	1, 424, 755
Fluorspar ... short tons	128, 657	2, 341, 277	112, 546	2, 034, 728
Fuller's earth ... do	234, 152	3, 356, 482	264, 478	3, 767, 038
Garnet for abrasive purposes ... do	6, 397	523, 875	6, 939	573, 525
Gems and precious stones	------------	(15)	------------	(15)
Graphite:				
Amorphous ... short tons	2, 975	40, 500	2, 595	35, 850
Crystalline ... pounds	4, 989, 200	178, 842	5, 224, 400	197, 121
Grindstones and pulpstones ... short tons	38, 339	1, 873, 234	31, 931	1, 554, 750
Gypsum ... do	5, 635, 441	46, 721, 219	5, 346, 888	42, 174, 454
Lime ... do	4, 560, 398	41, 566, 452	4, 414, 932	38, 638, 413
Magnesite (expressed as equivalent crude) ... short tons	133, 500	1, 200, 830	121, 490	1, 090, 550
Mica:				
Scrap ... do	7, 043	136, 643	6, 280	110, 139
Sheet ... pounds	2, 172, 159	400, 184	1, 512, 492	212, 482
Millstones	------------	45, 937	------------	35, 438
Mineral paints:				
Natural pigments [16] ... short tons	(16)	(16)	(16)	(16)
Zinc and lead pigments [17] ... do	184, 289	25, 896, 269	191, 853	25, 275, 975
Mineral waters ... gallons sold	(15)	(15)	(15)	(15)
Natural gas ... M cubic feet	1, 313, 019, 000	[18] 300, 168, 000	1, 445, 428, 000	317, 930, 000
Natural gasoline ... gallons	1, 363, 090, 000	136, 412, 000	1, 641, 144, 000	118, 688, 000
Oilstones, etc ... short tons	1, 680	223, 359	1, 048	233, 545
Peat ... do	61, 936	364, 413	(15)	(15)
Petroleum ... barrels (42 gallons)	770, 874, 000	1, 447, 760, 000	901, 129, 000	1, 172, 830, 000
Phosphate rock ... long tons	3, 209, 976	10, 893, 800	3, 170, 699	11, 253, 352
Potassium salts ... short tons	[19] 25, 060	1, 083, 064	[19] 49, 500	2, 448, 146
Pumice ... do	53, 887	208, 504	53, 298	221, 481
Pyrites ... long tons	166, 559	616, 668	215, 786	804, 006
Salt ... short tons	7, 371, 600	25, 055, 012	7, 568, 690	24, 817, 962
Sand:				
Glass ... do	2, 274, 218	3, 615, 371	2, 171, 693	3, 257, 790
Molding, building, etc., and gravel ... do	180, 826, 600	107, 723, 330	195, 282, 576	112, 271, 996
Sand-lime brick [12] ... thousands	330, 586	3, 981, 492	319, 618	3, 645, 842
Silica (quartz) ... short tons	27, 743	274, 333	22, 144	194, 040
Slate ... do	718, 000	12, 352, 767	692, 040	11, 380, 736
Stone ... do	124, 496, 360	188, 308, 590	136, 345, 130	198, 647, 222
Sulphur ... long tons	2, 072, 657	37, 300, 000	2, 072, 109	38, 300, 000
Sulphuric acid (60° Baumé) from copper and zinc smelters ... short tons	1, 068, 449	8, 274, 242	1, 041, 399	8, 234, 313
Talc and soapstone [20] ... do	181, 568	2, 110, 994	192, 316	2, 234, 724
Total value of nonmetallic products (approximate)	------------	4, 803, 080, 000	------------	4, 304, 100, 000
SUMMARY				
Total value of metallic products	------------	1, 402, 920, 000	------------	1, 217, 700, 000
Total value of nonmetallic products (exclusive of mineral fuels)	------------	1, 261, 164, 000	------------	1, 244, 053, 000
Total value of mineral fuels	------------	3, 541, 916, 000	------------	3, 060, 047, 000
Total value of "unspecified" (metallic and nonmetallic) products (partly estimated) [21]	------------	7, 600, 000	------------	[21] 8, 200, 000
Grand total approximate value of mineral products	------------	6, 213, 600, 000	------------	5, 530, 000, 000

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[6] Value not included in total value.

[12] Figures obtained through cooperation with Bureau of the Census.

[13] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

[14] Figures represent tripoli only. Value of diatomite is included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.

[15] No canvass. Estimate of value included in total value of nonmetallic products.

[16] Canvass discontinued after 1915. Value of iron ore sold for paint included under last item ("Unspecified").

[17] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

[18] Revised figures.

[19] K_2O content.

[20] Figures represent talc only. Value of soapstone is included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.

[21] Includes for 1927 the value of bismuth, cadmium sulphide and other cadmium compounds ($191,051), chats ($613,433), columbite ($378), flint lining for tube mills and pebbles for grinding ($46,856), gem feldspar ($2,500), iron ore sold for magnets, iron ore sold for paint ($132,007), lithium minerals ($39,650), natural magnesium salts ($1,000,850), calcareous marl ($180,166), greensand marl ($168,683), micaceous minerals ($35,148), molybdenum ($1,858,786), selenium ($491,996), silica sand and sandstone (finely ground) ($1,167,143), sodium salts (carbonate, bicarbonate, sulphate, and trona) from natural sources ($1,422,234), tellurium ($1,913), zircon ($364,600), and an estimate of the value of miscellaneous mineral products, statistics for which are not collected annually by the Bureau of Mines.

Value of mineral products of the United States, 1880–1927

Year	Metallic		Nonmetallic		Un-specified (metallic and non-metallic)	Total	
	Value	Percentage of increase or decrease	Value	Percentage of increase or decrease		Value	Percentage of increase or decrease
1880	$187,881,000	....	$173,582,000	....	$6,000,000	$367,463,000	....
1881	189,413,000	+0.8	207,207,000	+19	6,500,000	403,120,000	+10
1882	215,820,000	+14	230,786,000	+11	6,500,000	453,106,000	+12
1883	197,881,000	−8	243,680,000	+6	6,500,000	448,061,000	−1
1884	180,284,000	−9	221,756,000	−9	5,000,000	407,040,000	−9
1885	172.218,000	−4	242,333,000	+9	5,000,000	419,551,000	+3
1886	204,400,000	+19	250,995,000	+4	790,000	456,185,000	+9
1887	240,791,000	+18	294,057,000	+17	785,000	535,633,000	+17
1888	242,010,000	+.5	310,889,000	+6	900,000	553,799,000	+3
1889	250,325,000	+3	291,004,000	−6	997,000	542,326,000	−2
1890	303,440,000	+21	310,995,000	+7	994,000	615,429,000	+13
1891	280,485,000	−8	319,364,000	+3	1,000,000	600,849,000	−2
1892	283,715,000	+1	337,517,000	+6	1,000,000	622,232,000	+4
1893	223,154,000	−21	321,339,000	−5	1,000,000	545,493,000	−12
1894	186,835,000	−16	362,410,000	+13	1,000,000	550,245,000	+.9
1895	248,033,000	+33	393,658,000	+9	1,000,000	642,691,000	+17
1896	252,075,000	+2	387,966,000	−1	1,000,000	641,041,000	−.3
1897	269,934,000	+7	380,678,000	−2	1,000,000	651,612,000	+2
1898	308,247,000	+14	417,795,000	+10	1,000.000	727,042,000	+12
1899	483,521,000	+57	525,575,000	+26	1,000,000	1,010,096,000	+39
1900	513,732,000	+6	594,204,000	+13	1,000,000	1,108,936,000	+10
1901	493,314,000	−4	660,764,000	+11	1,000,000	1,155,078,000	+4
1902	604,517.000	+23	722,434,000	+9	1,000,000	1,327,951,000	+15
1903	588,753,000	−3	905,628,000	+25	1,000,000	1,495,381,000	+13
1904	501,114,000	−15	857,667,000	−5	400,000	1,359,181,000	−9
1905	702,585,000	+40	920,780,000	+7	400,000	1,623,765,000	+19
1906	886,180,000	+26	1,014,500,000	+10	200,000	1,900,880,000	+17
1907	904,108,000	+2	1,165,376,000	+15	86,000	2,069,570,000	+9
1908	550,768,000	−39	1,040,761,000	−11	244,000	1,591,773,000	−23
1909	754,944,000	+37	1,131,866,000	+9	297,000	1,887,107,000	+19
1910	749,879,000	−.7	1,237,668,000	+9	297,000	1,987,844,000	+5
1911	680,907,000	−9	1,242,942,000	+.4	232,000	1,924,081,000	−3
1912	862,008,000	+27	1,375,420,000	+11	366,000	2,237,794,000	+16
1913	878,869,000	+2	1,554,298,000	+13	378,000	2,433,545,000	+9
1914	686,639,000	−22	1,424,063,000	−8	470,000	2,111,172,000	−13
1915	991,730,000	+44	1,400,484,000	−2	2,430,000	2,394,644,000	+13
1916	1,620,745,000	+63	1,884,413,000	+35	3,281,000	3,508,439,000	+47
1917	2,086,234,000	+29	2,900,462,000	+54	5,800,000	4,992,496,000	+42
1918	2,153,318,000	+3	3,380,690,000	+17	6,700,000	5,540,708,000	+11
1919	1,359,744,000	−37	3,232,626,000	−4	3,400,000	4,595,770,000	−17
1920	1,762,350,000	+30	5,214,170,000	+61	4,820,000	6,981,340,000	+52
1921	654,130,000	−63	3,481,720,000	−33	2,650,000	4,138,500,000	−41
1922	987,180,000	+51	3,656,410,000	+5	3,700,000	4,647,290,000	+12
1923	1,510,930,000	+53	4,471,620,000	+22	3,950,000	5,986,500,000	+29
1924	1,232,330,000	−18	4,067,730,000	−9	5,740,000	5,305,800,000	−11
1925	1,380,280,000	+12	4,291,100,000	+5	6,250,000	5,677,630,000	+7
1926	1,402,920,000	+2	4,803,080,000	+12	7,600,000	6,213,600,000	+9
1927	1,217,700,000	−13	4,304,100,000	−10	8,200,000	5,530,000,000	−11
Grand total	33,638,370,000	....	69,160,562,000	....	120,857,000	102,919,789,000	....

Value of mineral products of the United States, 1923–1927, by States [1]

State	1923	1924	1925	1926	1927
Alabama	$82, 496, 430	$77, 315, 758	$77, 139, 340	$83, 709, 894	$78, 010, 669
Alaska	20, 241, 137	17, 361, 834	18, 286, 320	17, 606, 890	14, 402, 449
Arizona	104, 940, 213	100, 327, 062	114, 202, 670	115, 047, 987	100, 558, 556
Arkansas	41, 954, 319	61, 748, 999	87, 185, 532	84, 485, 672	79, 449, 100
California	375, 492, 868	428, 175, 652	496, 923, 376	524, 282, 257	479, 457, 072
Colorado	61, 379, 146	61, 487, 882	63, 512, 998	65, 597, 487	58, 855, 263
Connecticut	7, 177, 266	8, 129, 332	6, 755, 454	7, 695, 341	7, 294, 106
Delaware	416, 074	512, 105	539, 261	375, 945	493, 377
District of Columbia	929, 768	813, 608	954, 795	987, 289	1, 574, 719
Florida	12, 557, 822	13, 120, 295	16, 625, 699	19, 700, 522	18, 095, 901
Georgia	14, 300, 313	14, 946, 610	16, 503, 741	17, 479, 967	16, 758, 590
Idaho	27, 105, 344	27, 831, 623	31, 611, 166	31, 752, 821	29, 183, 929
Illinois	282, 760, 623	235, 796, 027	231, 658, 604	237, 241, 600	180, 393, 779
Indiana	130, 885, 954	112, 299, 075	111, 833, 732	118, 692, 304	107, 578, 234
Iowa	46, 174, 897	40, 459, 869	38, 420, 203	35, 971, 787	33, 420, 575
Kansas	110, 630, 255	105, 005, 476	142, 944, 214	165, 060, 612	120, 368, 526
Kentucky	148, 853, 786	120, 510, 775	131, 370, 840	146, 768, 273	152, 614, 177
Louisiana	61, 199, 048	56, 930, 681	60, 503, 891	62, 203, 543	51, 266, 921
Maine	7, 565, 553	6, 035, 160	5, 838, 718	5, 785, 619	5, 475, 635
Maryland	21, 189, 542	18, 506, 867	21, 557, 810	24, 066, 996	20, 469, 294
Massachusetts	14, 781, 129	15, 725, 882	16, 831, 529	16, 786, 577	16, 295, 373
Michigan	128, 291, 450	114, 239, 386	122, 212, 254	130, 860, 609	124, 029, 572
Minnesota	174, 105, 328	107, 844, 680	110, 252, 956	118, 361, 306	102, 972, 773
Mississippi	2, 163, 343	2, 090, 422	2, 171, 945	1, 882, 986	2, 553, 633
Missouri	79, 201, 473	81, 054, 122	92, 548, 473	90, 003, 537	75, 890, 415
Montana	74, 707, 269	70, 631, 806	79, 261, 284	79, 766, 380	68, 264, 687
Nebraska	3, 302, 397	3, 209, 425	3, 358, 585	3, 322, 460	3, 541, 792
Nevada	28, 598, 627	26, 225, 943	26, 469, 901	27, 613, 232	26, 773, 295
New Hampshire	3, 572, 615	3, 378, 165	3, 464, 837	4, 144, 645	3, 447, 105
New Jersey	72, 602, 066	75, 271, 009	76, 761, 313	77, 065, 713	73, 090, 810
New Mexico	23, 791, 047	23, 913, 528	25, 696, 009	28, 513, 991	28, 608, 776
New York	89, 975, 134	95, 435, 299	102, 035, 557	112, 016, 262	112, 209, 533
North Carolina	10, 020, 559	9, 261, 467	9, 504, 063	10, 992, 793	11, 703, 671
North Dakota	3, 473, 018	2, 735, 477	2, 662, 029	2, 804, 837	2, 869, 663
Ohio	287, 868, 728	249, 049, 648	247, 506, 588	253, 883, 995	226, 962, 729
Oklahoma	398, 810, 630	393, 030, 665	501, 767, 118	569, 518, 693	521, 594, 732
Oregon	6, 054, 487	7, 364, 232	7, 826, 711	6, 941, 355	6, 821, 224
Pennsylvania	1, 225, 036, 404	1, 011, 630, 879	867, 196, 142	1, 055, 766, 077	936, 773, 189
Rhode Island	1, 022, 528	1, 132, 641	1, 151, 857	1, 339, 398	1, 310, 756
South Carolina	3, 550, 059	3, 444, 366	3, 507, 804	3, 677, 209	4, 251, 137
South Dakota	7, 372, 368	6, 925, 676	7, 971, 650	7, 595, 358	8, 463, 952
Tennessee	41, 553, 789	35, 354, 525	38, 869, 198	39, 296, 668	37, 874, 981
Texas	260, 450, 913	272, 729, 023	351, 211, 629	420, 586, 730	374, 593, 420
Utah	86, 221, 000	84, 356, 626	100, 275, 442	98, 985, 218	90, 388, 475
Vermont	13, 910, 449	14, 549, 429	14, 408, 933	14, 955, 161	14, 702, 891
Virginia	48, 052, 018	37, 962, 143	41, 038, 393	46, 136, 458	41, 322, 998
Washington	22, 169, 191	21, 159, 370	22, 382, 132	21, 256, 952	21, 965, 917
West Virginia	412, 866, 535	307, 314, 205	333, 527, 697	395, 941, 940	366, 643, 205
Wisconsin	19, 089, 600	15, 796, 720	19, 205, 380	20, 711, 736	21, 776, 847
Wyoming	77, 664, 547	75, 494, 166	78, 754, 915	78, 988, 066	56, 166, 600

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[1] In this table iron ore, not pig iron, is taken as the basis of valuation of iron, and in the case of other metals mine production (recoverable content of metals) is the basis.

Mineral products of the United States and principal producing States in 1927

Rank in value	Product	Principal producing States[1]	
		In order of quantity	In order of value
18	Aluminum		New York, North Carolina, Tennessee.
37	Antimonial lead	Not separable by States	Not separable by States.
56	Arsenious oxide	Montana, Utah	Rank same as for quantity.
67	Asbestos	Georgia, Arizona, Maryland	Arizona, Georgia, Maryland.
	Asphalt:		
30	Native	Texas, Kentucky, Utah, Oklahoma	Kentucky, Texas, Utah, Alabama.
24	Oil	Not separable by States	Not separable by States.
44	Barite (crude)	Missouri, Georgia, Tennessee, California	Rank same as for quantity.
41	Bauxite	Arkansas, Georgia, Alabama	Do.
63	Bismuth	Not separable by States	Not separable by States.
36	Borates	California, Nevada	Rank same as for quantity.
29	Briquets, fuel	Wisconsin, Pennsylvania, Washington, Oregon	Wisconsin, Pennsylvania, Oregon, Washington.
60	Bromine	Michigan, California, Ohio, West Virginia	Rank same as for quantity.
54	Cadmium (metal and compounds)	Not separable by States	Not separable by States.
42	Calcium-magnesium chloride (natural)	Michigan, California, Ohio, West Virginia	Michigan, California, West Virginia, Ohio.
6	Cement	Pennsylvania, California, Indiana, Michigan	Rank same as for quantity.
58	Chats	Missouri, Oklahoma, Kansas	Do.
84	Chromite	California	Do.
4	Clay products		Ohio, Pennsylvania, New Jersey, Illinois.
25	Clay, raw	Pennsylvania, Missouri, Ohio, New Jersey	Pennsylvania, Missouri, Georgia, New Jersey.
1	Coal:		
	Bituminous	West Virginia, Pennsylvania, Kentucky, Illinois	Pennsylvania, West Virginia, Kentucky, Illinois.
	Pennsylvania anthracite	Pennsylvania	Rank same as for quantity.
7	Coke	Pennsylvania, Ohio, Indiana, Alabama	Pennsylvania, Indiana, Ohio, New York.
86	Columbite	South Dakota	Rank same as for quantity.
8	Copper	Arizona, Utah, Montana, Michigan	Do.
46	Diatomite and tripoli	California, Illinois, Oklahoma, Missouri	Do.
83	Emery	New York, Virginia	Do.
47	Feldspar (crude)	North Carolina, Maine, New Hampshire, New York	Do.
15	Ferro-alloys	Pennsylvania, New York, Ohio, Iowa	Pennsylvania, New York, Ohio, Alabama.
78	Flint lining for tube mills	South Dakota, Minnesota	Rank same as for quantity.
40	Fluorspar	Kentucky, Illinois, Colorado, New Mexico	Do.
34	Fuller's earth	Georgia, Florida, Nevada, Illinois	Georgia, Florida, Illinois, Nevada.
59	Garnet, abrasive	New York, New Hamsphire	Rank same as for quantity.
(2)	Gems and precious stones	No canvass for 1927	No canvass for 1927.
16	Gold	California, South Dakota, Alaska, Colorado	Rank same as for quantity.
70	Graphite		Alabama, Texas, Rhode Island, Michigan.
	Amorphous	Rhode Island, Nevada, Michigan	Rhode Island, Michigan, Nevada.
	Crystalline	Alabama, Texas, California, Montana	Rank same as for quantity.
45	Grindstones and pulpstones	Ohio, West Virginia, Michigan, Washington	Do.
17	Gypsum	New York, Iowa, Michigan, Texas	New York, Iowa, Ohio, Michigan.

10	Iron ore	Minnesota, Michigan, Alabama, Pennsylvania	Minnesota, Michigan, Alabama, New York.
3	Iron, pig	Pennsylvania, Ohio, Illinois, Indiana	Rank same as for quantity.
13	Lead	Missouri, Utah, Idaho, Oklahoma	Do.
19	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Ohio, Pennsylvania, Massachusetts, Missouri.
76	Lithium minerals	New Mexico, South Dakota, California, Maine	Rank same as for quantity.
52	Magnesite	Washington, California	Do.
62	Magnesium	Michigan, New York	New York, Michigan.
53	Magnesium salts (natural)	Michigan, California	Rank same as for quantity.
51	Manganese ore	Montana, Arizona, Virginia, Idaho	Montana, Virginia, Arkansas, Idaho.
31	Manganiferous ore	Minnesota, Wisconsin, New Mexico, Michigan	Rank same as for quantity.
65	Manganiferous zinc residuum	New Jersey	Do.
	Marl:		
73	Calcareous	Virginia, California, West Virginia, South Carolina	Do.
74	Greensand	New Jersey, Texas, Delaware	Do.
48	Mercury	California, Texas, Oregon, Washington	Do.
68	Mica	North Carolina, New Hampshire, South Dakota, New Mexico	North Carolina, New Hampshire, South Dakota, Virginia.
	Scrap	do	Rank same as for quantity.
	Sheet	New Hampshire, North Carolina, Virginia, Connecticut	North Carolina, New Hampshire, Virginia, Connecticut.
80	Micaceous minerals	North Carolina, Georgia, Montana, Colorado	Rank same as for quantity.
79	Millstones		New York, Virginia, New Hampshire, North Carolina.
22	Mineral paints, zinc and lead pigments	Pennsylvania, Ohio, Illinois, Indiana	Pennsylvania, Ohio, Indiana, Illinois.
(2)	Mineral waters	No canvass for 1927	No canvass for 1927.
43	Molybdenum	Colorado, New Mexico, Arizona	Rank same as for quantity.
5	Natural gas	Oklahoma, Texas, California, Louisiana	West Virginia, California, Pennsylvania, Oklahoma.
11	Natural gasoline	Oklahoma, California, Texas, West Virginia	California, Oklahoma, Texas, West Virginia.
64	Nickel	Not separable by States	Not separable by States.
69	Oilstones, etc	Ohio, Indiana, New Hampshire, Arkansas	Arkansas, Ohio, Indiana, New Hampshire.
(2)	Peat	No canvass for 1927	No canvass for 1927.
82	Pebbles for grinding	Minnesota, California	Rank same as for quantity.
2	Petroleum	Oklahoma, California, Texas, Kansas	Do.
27	Phosphate rock	Florida, Tennessee, Idaho, Wyoming	Do.
33	Platinum and allied metals	California, Alaska, Oregon	Do.
39	Potassium salts	California, Maryland, Pennsylvania, Delaware	California, Maryland, Delaware, Pennsylvania.
71	Pumice	Kansas, Nebraska, California, New Mexico	Kansas, Nebraska, California, Arizona.
55	Pyrites	California, Virginia	Rank same as for quantity.
23	Salt	Michigan, New York, Ohio, Kansas	Do.
12	Sand and gravel	New York, Illinois, Michigan, California	New York, Pennsylvania, Illinois, Ohio.
35	Sand-lime brick	Michigan, New Jersey, Massachusetts, Wisconsin	Michigan, Massachusetts, New Jersey, Wisconsin.
61	Selenium	Not separable by States	Not separable by States.
72	Silica (quartz)	California, Maryland, North Carolina, Wisconsin	California, Wisconsin, Maryland, North Carolina.
50	Silica sand and sandstone (finely ground)	West Virginia, New Jersey, Pennsylvania, Illinois	West Virginia, Pennsylvania, Ohio, Illinois.
21	Silver	Utah, Montana, Idaho, Arizona	Rank same as for quantity.
26	Slate		Pennsylvania, Vermont, New York, Virginia.
32	Sodium salts (other than NaCl) from natural sources.	California, Arizona, Wyoming, Nevada	California, Arizona, Wyoming, Washington.
9	Stone	Pennsylvania, Ohio, New York, Michigan	Indiana, Pennsylvania, New York, Ohio.
20	Sulphur	Texas, Louisiana, Utah, Nevada	Rank same as for quantity.
28	Sulphuric acid from copper and zinc smelters	Tennessee, Illinois, Pennsylvania, Ohio	Illinois, Tennessee, Pennsylvania, Ohio.
38	Talc and soapstone	New York, Vermont, Virginia, California	New York, Virginia, Vermont, California.
85	Tellurium	Not separable by States	Not separable by States.

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[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.

[2] No canvass for 1927.

Mineral products of the United States and principal producing States in 1927—Continued

Rank in value	Product	Principal producing States	
		In order of quantity	In order of value
81	Tin	Alaska, South Dakota	Rank same as for quantity.
	Titanium ore:		
77	Ilmenite	California, Florida, Virginia	Florida, California, Virginia.
75	Rutile	Florida, Virginia	Rank same as for quantity.
57	Tungsten ore	Nevada, Colorado, California, South Dakota	Do.
49	Uranium and vanadium ores	Colorado, Utah	Do.
14	Zinc	Oklahoma, Kansas, New Jersey, Montana	Do.
66	Zircon	Florida	Do.

States and their principal mineral products in 1927 [1]

State	Rank	Percentage of total value for United States	Principal mineral products in order of value
Alabama	16	1.60	Coal, iron ore, cement, clay products.
Alaska	37	.29	Copper, gold, coal, silver.
Arizona	14	2.05	Copper, gold, silver, lead.
Arkansas	20	1.21	Petroleum, coal, natural gas, natural gasoline.
California	3	9.37	Petroleum, natural gasoline, natural gas, cement.
Colorado	21	1.20	Coal, gold, zinc, lead.
Connecticut	40	.15	Stone, clay products, lime, sand and gravel.
Delaware	50	.01	Clay products, stone, sand and gravel, greensand marl.
District of Columbia	48	.03	Sand and gravel, clay products, sand-lime brick, stone.
Florida	33	.37	Phosphate rock, stone, fuller's earth, sand and gravel.
Georgia	34	.34	Stone, clay products, cement, fuller's earth.
Idaho	27	.60	Lead, silver, zinc, stone.
Illinois	7	3.68	Coal, clay products, petroleum, cement.
Indiana	12	2.19	Coal, stone, cement, clay products.
Iowa	26	.68	Coal, cement, gypsum, clay products.
Kansas	10	2.46	Petroleum, zinc, natural gas, cement.
Kentucky	8	3.11	Coal, petroleum, clay products, natural gas.
Louisiana	23	1.05	Petroleum, natural gas, natural gasoline, salt.
Maine	42	.11	Stone, lime, clay products, slate.
Maryland	32	.42	Coal, clay products, cement, sand and gravel.
Massachusetts	35	.33	Stone, clay products, sand and gravel, lime.
Michigan	9	2.53	Iron ore, copper, cement, sand and gravel.
Minnesota	13	2.10	Iron ore, stone, cement, clay products.
Mississippi	47	.05	Sand and gravel, clay products, natural gas, stone.
Missouri	17	1.55	Lead, clay products, cement, coal.
Montana	19	1.39	Copper, zinc, coal, petroleum.
Nebraska	44	.07	Sand and gravel, cement, clay products, stone.
Nevada	29	.55	Copper, gold, silver, gypsum.
New Hampshire	45	.07	Stone, clay products, sand and gravel, feldspar.
New Jersey	18	1.49	Clay products, zinc, cement, stone.
New Mexico	28	.58	Copper, coal, zinc, petroleum.
New York	11	2.29	Clay products, stone, cement, gypsum.
North Carolina	38	.24	Stone, clay products, sand and gravel, copper.
North Dakota	46	.06	Coal, sand and gravel, clay products, natural gas.
Ohio	6	4.63	Clay products, coal, natural gas, stone.
Oklahoma	2	10.70	Petroleum natural gas, natural gasoline, zinc.
Oregon	41	.14	Cement, stone, sand and gravel, clay products.
Pennsylvania	1	19.11	Coal, cement, clay products, natural gas.
Rhode Island	49	.03	Stone, sand and gravel, clay products, lime.
South Carolina	43	.09	Stone, clay products, sand and gravel, barite.
South Dakota	39	.17	Gold, cement, stone, sand and gravel.
Tennessee	25	.77	Coal, cement, stone, clay products.
Texas	4	7.64	Petroleum, natural gas, sulphur, natural gasoline.
Utah	15	1.84	Copper, lead, coal, silver.
Vermont	36	.30	Stone, slate, lime, talc.
Virginia	24	.84	Coal, cement, clay products, stone.
Washington	30	.45	Coal, cement, clay products, sand and gravel.
West Virginia	5	7.48	Coal, natural gas, petroleum, clay products.
Wisconsin	31	.44	Stone, zinc, sand and gravel, iron ore.
Wyoming	22	1.15	Petroleum, coal, natural gas, natural gasoline.

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[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and in the case of other metals mine production (recoverable content of metals) is the basis.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver [1]	Copper [2]	Lead [2]	Zinc [2]	Year	Silver [1]	Copper [2]	Lead [2]	Zinc [2]
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$0.98	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

[1] Average price furnished by Bureau of the Mint.

[2] Average price, all grades.

DETAILED TABLES

ABRASIVE MATERIALS

Natural abrasives sold by producers in the United States, 1918–1927 [1]

Year	Millstones [2]	Grindstones		Pulpstones [3]		Oilstones and scythestones		Emery	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	$92,514	56,554	$1,262,602	8,785	$513,680	1,010	$189,033	[4] 10,422	[4] $112,878
1919	66,972	40,755	993,959	6,110	342,056	1,463	235,943	2,601	23,203
1920	63,325	44,832	1,239,990	8,652	467,014	1,144	231,747	2,327	21,685
1921	24,524	16,310	477,259	10,030	750,063	831	173,025	305	2,250
1922	20,853	21,367	574,900	5,157	445,286	1,016	197,450	1,468	17,511
1923	22,229	37,384	1,008,899	9,186	680,416	1,223	231,812	2,286	29,478
1924	30,125	28,991	852,260	9,193	814,409	1,056	258,943	2,195	19,756
1925	22,490	28,970	864,637	8,370	841,302	970	272,224	769	5,907
1926	45,937	28,669	875,240	9,670	997,994	1,680	223,359	386	3,641
1927	35,438	23,222	633,207	8,709	921,543	1,048	233,545	506	5,855

Year	Garnet		Diatomite		Tripoli (including rottenstone)			Pumice		Grinding pebbles and tube-mill lining	
						Value					
	Short tons	Value	Short tons	Value	Short tons	Crude (estimated)	As sold (crude and finished)	Short tons	Value	Short tons	Value
1918	4,696	$248,161	[5] 2,965	$24,947	19,982	$53,815	$199,854	30,637	$91,178	12,469	$129,485
1919	4,944	310,131	42,642	531,960	24,292	98,010	181,541	36,051	116,835	9,448	85,302
1920	5,476	434,425	61,922	1,079,693	40,233	164,076	569,677	41,838	114,433	10,924	77,823
1921	3,048	260,687	55,134	682,616	12,340	53,892	213,013	37,108	158,540	989	14,637
1922	7,054	566,879	44,761	386,669	30,205	105,309	316,728	45,262	175,600	3,159	30,798
1923	9,006	688,437	65,833	699,406	27,082	62,190	382,757	56,575	214,169	4,551	51,795
1924	8,290	674,176	63,163	693,917	28,476	55,537	389,409	43,651	190,253	2,532	37,429
1925	8,429	712,853	73,030	922,281	29,388	58,770	434,886	40,380	179,020	3,831	50,147
1926	6,397	523,875	[6] 87,126	[6] 1,081,564	31,369	65,022	523,609	53,887	208,504	6,219	85,146
1927	6,939	573,525	(7)	(7)	26,099	66,452	447,068	53,298	221,481	3,342	46,856

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[1] For figures on abrasive feldspar and quartz, see sections on feldspar and silica.
[2] Figures for quantity not available.
[3] Exclusive of sales in Washington prior to 1923.
[4] Includes corundum for which figures may not be published.
[5] Exclusive of considerable production for special uses upon which the Bureau of Mines is not at liberty to report.
[6] Partly estimated.
[7] Bureau of Mines not at liberty to publish figures.

Value of abrasive materials imported for consumption in the United States, 1918–1927

Material	1918	1919	1920	1921	1922
Millstones and burrstones	$20,017	$26,356	$20,954	$13,556	$15,356
Grindstones	27,361	50,551	77,046	81,880	81,733
Hones, oilstones, and whetstones	6,075	12,199	56,416	35,761	48,938
Emery and corundum	614,167	595,203	617,187	393,454	389,390
Garnet	(1)	(1)	(1)	(1)	[1] 1,837
Diatomaceous earth, tripoli, and rottenstone	11,128	12,545	16,323	13,203	10,429
Pumice	33,014	119,781	249,995	173,201	118,458
Diamond dust and bort	475,870	1,420,442	3,387,488	466,345	1,029,261
Flint, flints, and flint stones, unground	127,808	250,096	338,630	116,157	145,805

Material	1923	1924	1925	1926	1927
Millstones and burrstones	$20,102	$6,311	$8,413	$6,266	$12,726
Grindstones	106,028	122,440	124,319	120,335	134,804
Hones, oilstones, and whetstones	53,233	43,579	49,108	63,152	67,368
Emery and corundum	722,688	364,755	313,718	616,700	264,613
Garnet	93,803	54,402	200		
Diatomaceous earth, tripoli, and rottenstone	11,779	9,504	6,589	14,544	15,403
Pumice	128,693	111,284	130,460	129,449	124,074
Diamond dust and bort	228,409	259,482	760,476	271,382	62,045
Flint, flints, and flint stones, unground	130,974	114,958	105,041	120,078	93,658

[1] Not separately classified prior to change in tariff, Sept. 22, 1922.

Value of domestic abrasive materials exported, 1918–1927

Material	1918	1919	1920	1921	1922
Grindstones	$210, 889	$297, 068	$424, 322	$281, 976	$281, 413
Abrasive wheels, emery, and other	3, 862, 531	3, 032, 067	2, 791, 128	1, 318, 804	644, 151
All other natural abrasives, hones, whetstones, etc	1, 982, 822	2, 809, 231	3, 810, 171	1, 719, 810	292, 051

Material	1923	1924	1925	1926	1927
Grindstones	$499, 123	$481, 397	$553, 750	$629, 748	$578, 113
Abrasive wheels, emery, and other	571, 733	521, 840	439, 904	248, 631	240, 027
All other natural abrasives, hones, whetstones, etc	342, 737	173, 731	195, 915	323, 447	419, 088

ALUMINUM

[See Bauxite and aluminum]

ANTIMONY AND ANTIMONIAL LEAD

Mine production of antimony ores in the United States, 1918–1927, in short tons

Year	Ore	Antimony content	Year	Ore	Antimony content
1918	190	50	1923	40	10
1919			1924	113	33
1920			1925	123	33
1921			1926	99	43
1922	20	4	1927		

Smelter production of metallic antimony in the United States, 1918–1927 [1]

Year	From domestic ores		From foreign ores		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	127	$32, 004	2, 490	$627, 480	2, 617	$659, 484
1919			(²)	(²)	(²)	(²)
1920			(²)	(²)	(²)	(²)
1925			(²)	(²)	(²)	(²)
1926	(²)	(²)	(²)	(²)	(²)	(²)
1927			(²)	(²)	(²)	(²)

[1] No production reported 1921 to 1924.

[2] Only 2 smelters reported production in 1919, 1926, and 1927, 1 in 1920, and 1 in 1925, and the Bureau of Mines is not at liberty to publish the figures.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1918–1927

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1918	5, 226	$1, 317, 000	1923	8, 021	$1, 272, 800
1919	4, 399	717, 900	1924	9, 404	2, 022, 600
1920	5, 600	938, 560	1925	10, 840	3, 794, 000
1921	4, 720	464, 400	1926	16, 230	5, 194, 400
1922	7, 090	765, 700	1927	12, 400	3, 060, 300

[1] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1918–1927

Year	Short tons	Value	Antimony content (short tons)	Year	Short tons	Value	Antimony content (short tons)
1918	18, 570	$2, 826, 350	2, 566	1923	14, 190	$1, 950, 370	2, 170
1919	13, 874	1, 513, 968	1, 943	1924	20, 787	3, 376, 713	2, 763
1920	12, 535	1, 963, 255	2, 033	1925	19, 667	3, 785, 547	2, 624
1921	10, 064	870, 059	1, 589	1926	22, 524	3, 916, 714	2, 693
1922	8, 075	844, 993	1, 441	1927	24, 347	3, 277, 043	2, 736

Antimony imported for consumption in the United States, 1918–1927

Year	Antimony ore [1]			Liquated antimony sulphide [2]		Metallic antimony [3]		Antimony oxides and other compounds [4]	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1918	3, 363	1, 425	$177, 731	833	$113, 258	14, 011	$3, 065, 619	18	$11, 904
1919	993	409	54, 477	278	19, 202	7, 159	1, 021, 587	126	9, 501
1920	1, 709	682	70, 285	1, 375	123, 902	9, 817	1, 216, 376	298	25, 260
1921	213	98	11, 682	353	17, 577	10, 130	784, 146	154	15, 558
1922	---	---	---	689	40, 108	9, 344	659, 242	379	65, 538
1923	(5)	1, 047	44, 721	835	64, 493	6, 763	641, 804	2, 277	288, 206
1924	(5)	899	62, 999	558	52, 393	6, 778	840, 434	1, 207	190, 252
1925	1, 359	773	47, 084	760	115, 990	9, 857	2, 362, 915	1, 792	349, 990
1926	2, 497	1, 559	287, 258	2, 040	343, 705	11, 506	3, 144, 330	2, 259	517, 584
1927	3, 566	2, 015	282, 098	1, 077	134, 949	9, 891	2, 111, 411	1, 803	484, 873

[1] Classified in tariff classification as "Antimony ore and stibnite containing antimony."

[2] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead" also as "needle or liquated antimony."

[3] Classified in tariff classification as "Antimony regulus or metal."

[4] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."

[5] Figures not available.

Foreign antimony (matte, regulus, or metal) exported from the United States, 1918-1927

Year	Pounds	Value	Year	Pounds	Value
1918	1, 410, 970	$164, 666	1923	15, 958	$1, 047
1919 [1]	429, 059	33, 913	1924	279, 920	14, 441
1920	896, 034	51, 607	1925	188, 976	17, 376
1921	299, 776	15, 741	1926	367, 942	41, 554
1922 [2]	37, 218	1, 548	1927	726, 694	72, 280

[1] Also 3 short tons of antimony ore, containing 5,380 pounds of antimony, valued at $1,665, was exported in 1919.

[2] During 1922 domestic exports of "matte, regulus, or metal" were 224,610 pounds, valued at $13,961. This is the first export of domestic antimony of which there is any record. However, foreign antimony manufactured in the United States and exported would be classed as domestic exports. Similar exports for 1923 to 1927 are not shown.

ARSENIC

White arsenic (refined and crude) sold by producers in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	[1] 6, 323	$1, 213, 000	1923	14, 271	$2, 808, 801
1919	[1] 6, 029	1, 181, 684	1924	14, 453	2, 655, 015
1920	11, 502	2, 021, 356	1925	12, 317	1, 199, 247
1921	4, 786	717, 700	1926	11, 805	674, 350
1922	10, 027	1, 475, 229	1927	11, 560	725, 360

[1] In addition to the arsenious oxide (or white arsenic) elemental arsenic was produced from ore in 1918 and 1919. The totals shown include this elemental arsenic.

Arsenic compounds imported for consumption in the United States, 1918–1927

Year	Arsenious acid (white arsenic, As_2O_3)		Arsenic sulphide (realgar and orpiment)		Sheep dip		Paris green and London purple	
	Short tons	Value	Short tons	Value	Pounds	Value	Pounds	Value
1918	1, 847	$441, 212	4, 842	$840, 600	(1)	$23, 538	----------	----------
1919	4, 389	624, 494	2, 151	316, 687	146, 803	12, 346	18	$14
1920	3, 740	532, 635	4, 080	684, 016	70, 168	5, 150	772	277
1921	1, 669	253, 250	3, 343	531, 322	61, 377	6, 362	325	123
1922 [2]	1, 081	162, 494	3, 815	472, 044	70, 390	4, 877	3, 866	741
1923 [3]	10, 152	1, 985, 400	1, 097	268, 311	87, 739	5, 237	100, 781	20, 586
1924 [4]	8, 877	1, 597, 433	234	45, 246	114, 801	10, 764	76, 241	15, 683
1925 [5]	9, 316	1, 076, 073	476	63, 296	73, 477	4, 953	2, 880	702
1926 [6]	7, 703	510, 227	283	40, 718	119, 947	14, 070	4, 747	1, 011
1927 [7]	12, 517	921, 998	206	35, 089	102, 394	8, 952	----------	----------

[1] Figures not available.

[2] Also 41,296 pounds of "acid," valued at $4,195, and 22,487 pounds of "metallic arsenic," valued at $3,484, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff.

[3] Also 166,354 pounds of "acid," valued at $15,597; 174,415 pounds of "metallic arsenic," $37,314; and 26 pounds of "lead arsenate," $9.

[4] Also 420 pounds of "acid," valued at $121; 122,467 pounds of "metallic arsenic," $23,684; 3,585 pounds of "lead arsenate," $525; and 3,172 pounds of "calcium arsenate," $278.

[5] Also 59,112 pounds of "acid," valued at $2,676; 149,018 pounds of "metallic arsenic," $31,918; 10,467 pounds of "lead arsenate," $1,514; and 1,074 pounds of "calcium arsenate," $135.

[6] Also 2,340 pounds of "acid," valued at $165; 174,490 pounds of "metallic arsenic," $35,745; and 1,057 pounds of "calcium arsenate," $284.

[7] Also 11,685 pounds of "acid," valued at $470; 245,686 pounds of "metallic arsenic," $47,875; and 3,807 pounds of "calcium arsenate," $717.

Foreign arsenic and sulphide of, or orpiment, exported from the United States, 1918–1927 [1]

Year	Pounds	Value	Year	Pounds	Value
1918	80, 050	$12, 017	1921	23, 765	$2, 835
1919	----------	----------	1922	14, 290	1, 555
1920	13, 799	1, 827			

[1] Domestic exports not separately recorded. Foreign exports not separately recorded after 1922.

ASBESTOS

Asbestos sold by producers in the United States, 1918–1927, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	392	$101, 059	606	$17, 628	998	$118, 687
1919	502	229, 265	659	19, 000	1, 161	248, 265
1920	1, 245	661, 907	403	16, 324	1, 648	678, 231
1921	438	313, 268	393	23, 700	831	336, 968
1922	25	3, 320	42	6, 800	67	10, 120
1923	69	4, 433	158	5, 193	227	9, 626
1924	173	33, 941	127	8, 585	300	42, 526
1925	93	40, 750	1, 165	10, 950	1, 258	51, 700
1926	(1)	(1)	(1)	(1)	1, 358	134, 731
1927	(1)	(1)	(1)	(1)	2, 981	336, 882

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[1] Bureau of Mines not at liberty to publish figures.

Asbestos (unmanufactured) imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1918	137, 700	$6, 337, 608	697	$51, 053
1919	135, 270	7, 369, 685	1, 119	157, 416
1920	167, 558	9, 120, 253	615	141, 071
1921	72, 463	2, 948, 302	520	101, 600
1922	149, 427	5, 144, 700	376	49, 939
1923	212, 420	7, 445, 143	680	48, 525
1924	183, 250	5, 602, 945	1, 270	93, 163
1925	230, 520	7, 134, 302	1, 109	70, 846
1926	257, 621	8, 142, 505	1, 104	85, 922
1927	223, 693	8, 150, 340	309	48, 774

ASPHALT AND RELATED BITUMENS

Native asphalt and related bitumens sold at mines in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	60, 034	$780, 808	1923	400, 236	$2, 885, 631
1919	88, 281	682, 989	1924	562, 367	3, 958, 339
1920	198, 497	1, 213, 908	1925	584, 850	4, 148, 400
1921	296, 412	1, 985, 583	1926	715, 180	4, 484, 960
1922	327, 792	2, 253, 180	1927	839, 040	5, 605, 850

Asphalt, manufactured in the United States from petroleum, sold at refineries in 1918–1927

Year	From domestic petroleum		From foreign petroleum	
	Short tons	Value	Short tons	Value
1918	604, 723	$8, 796, 541	597, 697	$9, 417, 818
1919	614, 692	8, 727, 372	674, 876	7, 711, 510
1920	700, 496	11, 985, 457	1, 045, 779	14, 272, 862
1921	624, 220	9, 048, 221	908, 093	11, 761, 358
1922	805, 145	10, 385, 925	1, 242, 163	13, 899, 407
1923	995, 654	13, 060, 174	1, 378, 722	16, 840, 045
1924	1, 158, 456	14, 305, 007	1, 920, 915	21, 710, 793
1925	1, 206, 700	15, 305, 760	1, 971, 670	27, 520, 010
1926	1, 245, 160	15, 452, 940	2, 213, 310	31, 098, 460
1927	**1, 525, 420**	**19, 019, 150**	**2, 426, 030**	**35, 771, 940**

Asphalt and related bitumens imported for consumption in the United States, 1918–1927

Year	Crude asphalt		Ozokerite	
	Short tons	Value	Short tons	Value
1918	114, 686	$624, 967	905	$147, 805
1919	104, 913	609, 923	1, 874	454, 840
1920	127, 027	1, 055, 951	2, 136	499, 758
1921	116, 450	972, 166	4, 274	546, 054
1922	120, 359	940, 873	4, 495	371, 161
1923	138, 430	1, 046, 603	2, 428	213, 407
1924	156, 662	1, 165, 253	1, 557	207, 833
1925	113, 384	823, 165	3. 088	361, 767
1926	140, 746	1, 025, 629	4, 144	479, 957
1927	157, 982	1, 138, 898	3, 800	579, 118

Year	Ichthyol		Bituminous limestone		Total	
	Pounds	Value	Short tons	Value	Short tons	Value
1918	65, 752	$39, 452	39	$2, 528	115, 663	$814, 752
1919	30, 976	38, 975	735	5, 576	107, 537	1, 109, 314
1920	98, 135	79, 133	1, 387	11, 665	130, 599	1, 646, 507
1921	76, 020	107, 752	12, 085	157, 124	132, 847	1, 783, 096
1922	74, 330	89, 150	4, 300	59, 590	129, 191	1, 460, 774
1923	[1] 20	15	6, 205	33, 303	147, 063	1, 293, 328
1924	9, 300	17, 058	3, 354	37, 906	161, 578	1, 428, 050
1925	560	1, 281	8, 778	84, 259	125, 250	1, 270, 472
1926	25, 396	34, 385	1, 886	19, 967	146, 789	1, 559, 938
1927	48, 199	58, 821	118	1, 500	161, 924	1, 778, 337

[1] As recorded by Bureau of Foreign and Domestic Commerce. Reclassification after change in tariff, Sept. 22, 1922, may account to some extent for great decrease.

Native asphalt and related bitumens exported from the United States, 1918–1927

Year	Unmanufactured		Manufactures of (value)	Total value
	Short tons	Value		
1918	22, 108	$577, 654	$577, 936	$1, 155, 590
1919	40, 208	1, 103, 930	606, 918	1, 710, 848
1920	51, 706	1, 356, 116	842, 074	2, 198, 190
1921	45, 367	1, 178, 038	621, 224	1, 799, 262
1922	57, 362	1, 344, 440	[1] 1, 261, 125	2, 605, 565
1923	72, 628	1, 500, 869	[1] 2, 075, 628	3, 576, 497
1924	52, 568	1, 245, 670	[1] 2, 212, 260	3, 457, 930
1925	32, 835	825, 654	[1] 2, 525, 618	3, 351, 272
1926	38, 218	905, 743	[1] 2, 189, 808	3, 095, 551
1927	39, 875	1, 034, 334	[1] 2, 399, 700	3, 434, 034

[1] Includes value of squares (10 by 10 feet) of roofing asphalt as follows: 1922, 588,636 squares, $870,200; 1923, 783,028 squares, $1,124,491; 1924, 697,293 squares, $998,469; 1925, 661,662 squares, $919,977; 1926, 938,176 squares, $1,212,409; 1927, 853,842 squares, $1,150,722. Corresponding exports not separately shown prior to 1922.

Exports of petroleum asphalt were not separately recorded until 1925, when 89,014 short tons, valued at $1,762,048, was exported. Similar exports in 1926 were 146,589 tons, valued at $3,183,746, and in 1927, 385,031 tons, valued at $8,325,413.

BARITE AND BARIUM PRODUCTS

BARITE

Crude barite sold or used by producers in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	155, 368	$1, 044, 905	1923	214, 183	$1, 664, 156
1919	209, 330	1, 727, 822	1924	196, 332	1, 540, 744
1920	228, 113	2, 142, 464	1925	228, 063	1, 703, 097
1921	66, 369	531, 958	1926	237, 875	1, 773, 293
1922	155, 040	1, 123, 950	1927	254, 265	1, 670, 878

Crude barite sold or used by producers in the United States, 1926 and 1927, by States

State	1926		1927	
	Short tons	Value	Short tons	Value
California	(1)	(1)	13, 919	$71, 708
Georgia	77, 654	$532, 706	94, 039	580, 300
Missouri	118, 919	946, 595	111, 456	797, 465
Nevada	(1)	(1)	884	3, 969
Tennessee	20, 910	155, 780	20, 537	129, 999
Other States [2]	20, 392	138, 212	13, 430	87, 437
	237, 875	1, 773, 293	254, 265	1, 670, 878

[1] Included under "Other States."

[2] 1926: Arizona, California, Illinois, Kentucky, Nevada, South Carolina, Virginia, and Wisconsin; 1927: South Carolina, Virginia, and Wisconsin.

Crude domestic and foreign barite used in the manufacture of barium products in the United States, 1918–1927, in short tons

Year	In manufacture of—		
	Ground barite	Lithopone	Barium chemicals
1918	62, 440	85, 282	38, 041
1919	64, 922	103, 688	32, 976
1920	79, 052	113, 181	37, 210
1921	28, 296	61, 359	10, 952
1922	48, 280	94, 259	25, 303
1923	47, 713	128, 547	34, 327
1924	42, 855	137, 127	33, 181
1925	56, 851	146, 693	29, 141
1926	69, 048	178, 889	33, 119
1927	73, 119	222, 791	34, 280

Crude barite imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	----------	----------	1923	15, 045	$93, 721
1919	118	$594	1924	21, 502	104, 264
1920	24, 874	146, 858	1925	28, 655	91, 016
1921	11, 054	59, 371	1926	51, 016	195, 004
1922	23, 239	104, 680	1927	70, 274	253, 284

Exports of barite are not separately reported.

BARIUM PRODUCTS

Barium products, manufactured in the United States from either domestic or imported crude ore, sold in 1918–1927, in short tons [1]

Product	1918	1919 [2]	1920	1921	1922
Ground barite	55, 086	57, 985	65, 748	27, 661	46, 176
Lithopone	62, 403	79, 643	89, 373	55, 016	83, 360
Barium chemicals:					
Binoxide	(3)	(3)	(3)	----------	(3)
Carbonate	7, 661	7, 135	7, 484	1, 956	2, 281
Chloride	4, 530	4, 509	3, 084	(3)	2, 022
Nitrate	(3)	(3)	(3)	----------	----------
Sulphate (blanc fixe)	9, 522	5, 227	8, 046	2, 471	7, 349
Other [4]	1, 473	3, 142	2, 146	1, 060	2, 249
	140, 675	157, 641	175, 881	88, 164	143, 437

Product	1923	1924	1925	1926	1927
Ground barite	39, 605	38, 296	49, 674	57, 812	57, 658
Lithopone	98, 199	109, 469	145, 019	159, 931	176, 994
Barium chemicals:					
Carbonate	6, 362	6, 058	4, 962	5, 394	5, 969
Chloride	3, 301	3, 859	(3)	4, 592	3, 708
Sulphate (blanc fixe)	6, 761	7, 796	11, 748	(3)	13, 395
Other [4]	379	441	1, 944	11, 925	871
	154, 607	165, 919	213, 347	239, 654	258, 595

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[1] In order to avoid duplication of figures, barium chemicals manufactured from other barium chemicals bought in open market are not included in table.

[2] Figures for 1919 represent production.

[3] Included under "Other."

[4] Figures cover chemicals, as follows—1918 and 1920: Binoxide, hydroxide, nitrate, and sulphide; 1919: Binoxide, nitrate, and sulphide; 1921 and 1925: Chloride, hydroxide, and sulphide; 1922: Binoxide, hydroxide, sulphide, and sulphydrate; 1923 and 1924: Hydroxide and sulphide; 1926: Hydroxide, sulphate, and sulphide; 1927: Binoxide, hydroxide, and sulphide.

Barium products imported for consumption in the United States, 1918–1927

Product	1918	1919	1920	1921	1922
Manufactured barite	----------	----------	$3, 017	$16, 942	$59, 453
Lithopone	----------	$122, 708	263, 240	432, 019	885, 671
Barium carbonate:					
Natural (ground witherite)	$14, 134	4, 739	61, 284	25, 188	39, 114
Manufactured (chemically precipitated)	----------	2, 666	37, 462	80, 603	210, 250
Barium binoxide	----------	----------	64, 447	127, 631	189, 334
Barium chloride	----------	19, 846	151, 778	72, 621	112, 785
Blanc fixe, or barium sulphate (chemically precipitated)	----------	90	8, 485	22, 470	76, 445
Barium hydroxide	(1)	(1)	(1)	(1)	[1] 6, 573
Barium nitrate	(1)	(1)	(1)	(1)	[1] 16, 795
	14, 134	150, 049	589, 713	777, 474	1, 596, 420

Product	1923	1924	1925	1926	1927	
					Short tons	Value
Manufactured barite	$88, 741	$38, 292	$40, 008	$44, 781	3, 259	$38, 568
Lithopone	776, 383	543, 025	478, 395	661, 700	7, 979	656, 166
Barium carbonate:						
Natural (ground witherite)	41, 823	56, 415	63, 634	80, 679	3, 300	65, 821
Manufactured (chemically precipitated)	79, 482	128, 217	160, 164	189, 167	4, 918	119, 014
Barium binoxide	152, 270	120, 374	70, 553	8, 157	6	1, 264
Barium chloride	75, 014	100, 810	67, 306	49, 426	1, 577	45, 285
Blanc fixe, or barium sulphate (chemically precipitated)	32, 063	50, 465	81, 439	136, 697	2, 400	107, 179
Barium hydroxide	16, 872	8, 241	5, 605	9, 789	222	12, 439
Barium nitrate	59, 766	54, 638	58, 192	49, 494	711	65, 284
	1, 322, 414	1, 100, 477	1, 025, 296	1, 229, 890	24, 372	1, 111, 020

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[1] Not separately classified prior to change in tariff, Sept. 22, 1922.

Prior to 1922 barium products had not been exported in appreciable quantity, and no separate record of the exports was kept. Exports of lithopone have been as follows: 1922, 1,616 short tons, valued at $169,982; 1923, 1,485 tons, $176,624; 1924, 923 tons, $104,783; 1925, 1,287 tons, $132,771; 1926, 1,941 tons, $200,412; 1927, 2,110 tons, $222,585.

BAUXITE AND ALUMINUM

BAUXITE

Bauxite produced in the United States, 1918–1927

Year	Georgia, Alabama, and Tennessee		Arkansas		Total	
	Long tons	Value	Long tons	Value	Long tons	Value
1918	42, 829	$314, 112	562, 892	$3, 133, 880	605, 721	$3, 447, 992
1919	43, 076	346, 588	333, 490	1, 855, 159	376, 566	2, 201, 747
1920	40, 029	349, 453	481, 279	2, 897, 892	521, 308	3, 247, 345
1921	14, 700	134, 400	124, 850	755, 400	139, 550	889, 800
1922	42, 810	329, 440	266, 790	1, 682, 890	309, 600	2, 012, 330
1923	28, 810	176, 030	493, 880	2, 980, 580	522, 690	3, 156, 610
1924	19, 940	156, 990	327, 630	1, 981, 000	347, 570	2, 137, 990
1925	20, 220	109, 800	296, 320	1, 878, 450	316, 540	1, 988, 250
1926	20, 680	116, 650	371, 570	2, 298, 550	392, 250	2, 415, 200
1927	17, 110	95, 920	303, 830	1, 892, 860	320, 940	1, 988, 780

Bauxite imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value
1918	3, 653	$14, 791	19, 711	$1, 523, 688
1919	6, 082	36, 820	17, 701	1, 372, 094
1920	42, 895	251, 284	22, 257	1, 843, 596
1921	27, 587	164, 589	5, 942	488, 785
1922	23, 656	93, 805	19, 617	961, 208
1923	119, 020	593, 882	78, 560	3, 380, 486
1924	201, 974	909, 493	77, 065	3, 979, 832
1925	353, 696	1, 549, 120	78, 633	4, 134, 455
1926	281, 644	1, 187, 497	87, 770	4, 741, 260
1927	356, 580	1, 572, 236	121, 858	7, 800, 491

ALUMINUM

Value of aluminum produced in the United States, 1918–1927

Year	Primary metal	Secondary metal [1]	Year	Primary metal	Secondary metal [1]
1918	$41, 159, 000	$10, 113, 600	1923	$28, 305, 000	$10, 824, 600
1919	38, 558, 000	12, 014, 600	1924	37, 607, 000	14, 596, 200
1920	41, 375, 000	9, 489, 100	1925	36, 430, 000	24, 816, 000
1921	10, 906, 000	3, 775, 400	1926	37, 583, 000	23, 868, 000
1922	13, 622, 000	6, 085, 900	1927	39, 266, 000	23, 469, 600

[1] Value of secondary aluminum based on average price at New York, as given by American Metal Market.

Aluminum imported for consumption in the United States, 1918–1927

Year	Crude and semicrude [1]		Manufactures of [2]	Total value
	Pounds	Value		
1918	1, 690, 683	$533, 704	$20, 882	$554, 586
1919	13, 852, 065	4, 530, 579	38, 016	4, 568, 595
1920	39, 298, 649	12, 183, 891	893, 131	13, 077, 022
1921	32, 559, 017	7, 627, 508	1, 262, 283	8, 889, 791
1922	43, 891, 933	8, 286, 819	1, 408, 193	9, 695, 012
1923	42, 476, 789	8, 316, 816	425, 747	8, 742, 563
1924	31, 809, 941	6, 859, 785	285, 251	7, 145, 036
1925	41, 997, 178	9, 805, 645	301, 122	10, 106, 767
1926	71, 391, 717	16, 421, 905	357, 472	16, 779, 377
1927	62, 575, 222	13, 316, 986	884, 992	14, 201, 978

[1] Includes crude aluminum, plates, sheets, wire, etc.
[2] Includes aluminum leaf, kitchen utensils, and all other manufactures of aluminum.

Aluminum and manufactures of aluminum exported from the United States, 1918–1927

Year	Crude and semicrude [1]		Manufactures of	Total value
	Pounds	Value		
1918	24, 135, 234	$8, 979, 315	$1, 890, 073	$10, 869, 388
1919	5, 020, 352	1, 744, 896	2, 145, 430	3, 890, 326
1920	9, 407, 631	3, 067, 617	2, 563, 164	5, 630, 781
1921	2, 196, 378	801, 075	2, 307, 782	3, 108, 857
1922	4, 347, 020	1, 127, 460	[2] 1, 708, 656	2, 836, 116
1923	5, 539, 671	1, 517, 562	[2] 2, 053, 977	3, 571, 539
1924	6, 343, 512	1, 632, 315	[2] 2, 540, 075	4, 172, 390
1925	12, 642, 034	3, 365, 815	[2] 2, 691, 256	6, 057, 071
1926	7, 634, 171	2, 135, 087	[3] 2, 317, 216	4, 452, 303
1927	14, 522, 560	3, 478, 649	[3] 2, 828, 772	6, 307, 421

[1] Includes ingots, metal and alloys, plates and sheets, etc.
[2] Represents value of 4,544,949 pounds in 1922, 5,402,034 pounds in 1923, 6,783,240 pounds in 1924, and 6,463,192 pounds in 1925 of tubes, moldings, castings, and other shapes, table, kitchen, or hospital utensils, and other manufactures. Figures of quantity not available prior to 1922.
[3] Tubes, moldings, castings, and other shapes exported amounted to 2,115,274 pounds in 1926 and 1,529,615 pounds in 1927; the quantity of table, kitchen, or hospital utensils, and other manufactures exported is not recorded.

BISMUTH

The bismuth produced in the United States is a by-product obtained in the refining of lead and tin bullion, part of which is from ores of foreign origin. Figures of production are not available for publication.

Bismuth imported for consumption in the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	135, 700	$277, 273	1923 [1]	62, 640	$146, 178
1919	57, 607	55, 179	1924 [1]	18, 494	39, 653
1920	72, 771	161, 877	1925 [1]	99, 694	187, 340
1921	94, 085	114, 891	1926 [1]	67, 505	173, 285
1922 [1]	121, 505	239, 777	1927 [1]	47, 732	100, 773

[1] Also 9,392 pounds of "compounds, mixtures, and salts of bismuth," valued at $8,681, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff. Similar additional imports in 1923 were 11,731 pounds, valued at $13,717; in 1924, 10,066 pounds, $12,533; in 1925, 16,983 pounds, $18,958; in 1926, 12,864 pounds, $18,864; and in 1927, 10,560 pounds, $15,080.

Exports of bismuth are not separately recorded.

BORAX

[See Sodium salts (natural)]

BRIQUETS (FUEL)

Fuel briquets produced in the United States, 1918–1927

Year	Short tons	Value
1918	477,235	$3,212,793
1919	295,734	2,301,054
1920	567,192	4,623,831
1921	398,949	3,632,301
1922	619,425	5,444,926
1923	696,810	$5,898,698
1924	580,470	4,986,622
1925	839,370	7,128,404
1926	995,332	8,533,179
1927	970,468	7,985,165

Briquets and other composition coals for fuels imported for consumption in the United States, 1918–1927

Year	Short tons	Value
1918 January to June	(1)	$280
1918 July to December	432	2,797
1919	136	1,050
1920	(2)	9
1921	66	251
1922	34,862	139,382
1923	19,559	$103,201
1924	38	443
1925	6,758	43,931
1926	123,593	736,804
1927	60,601	314,435

[1] Quantity not recorded prior to July, 1918.

[2] 112 pounds.

BROMINE

Bromine and bromine in compounds sold or used by producers in the United States, 1918–1927

Year	Pounds	Value
1918	1,727,156	$970,099
1919	1,854,971	1,234,969
1920	1,160,584	745,381
1921	711,953	172,759
1922	1,005,174	150,668
1923	842,352	$146,176
1924	2,033,804	594,685
1925	1,566,120	488,406
1926	1,245,760	426,837
1927	1,756,310	564,689

Imports of bromine have been as follows: 1927, none; 1926, 37,839 pounds, valued at $14,486; 1925, 8,009 pounds, $2,110; 1924, 37,318 pounds, $8,958; 1923, 782 pounds, $1,171; 1922, 1,094 pounds, $339; 1921, 300 pounds, $84. No imports were recorded for 1918 to 1920. Exports are not specifically shown.

CADMIUM

Cadmium produced in the United States, 1918–1927

Year	Metallic cadmium		Cadmium compounds	
	Pounds	Value	Estimated cadmium content (pounds)	Value
1918	127,164	$188,203	[1] 38,800	[1] $70,315
1919	99,939	121,926	[1] 23,400	[1] 37,436
1920	129,283	151,261	[1] 21,100	[1] 37,274
1921	68,501	67,131	[1] 49,100	[1] 71,336
1922	131,590	143,433	[1] 101,100	[1] 152,295
1923	183,816	161,758	(2)	(2)
1924	129,328	77,597	(2)	(2)
1925	502,824	276,553	113,000	127,304
1926	810,428	429,527	166,600	130,483
1927	1,074,654	[3] 645,000	229,000	191,051

[1] Cadmium sulphide only.
[2] Bureau of Mines not at liberty to publish figures.
[3] Value in 1927 based on the average market quotation of 60 cents a pound.

Imports of cadmium for consumption have been as follows: 1927, 22,400 pounds, valued at $13,172; 1926, none; 1925, 5 pounds, $6; 1924, 1,102 pounds, $743; 1923, 16 pounds, $119; 1922, 2,240 pounds, $2,434; 1921, 101 pounds, $216; 1918–1920, none.

Exports of cadmium are not separately recorded by the Bureau of Foreign and Domestic Commerce, and hence are not regularly available, but it is known that domestic cadmium was largely exported during the World War. Special canvasses showed that about 40,000 pounds of cadmium was exported in 1918, of which the larger part went to France.

CALCIUM CHLORIDE

Calcium-magnesium chloride, from natural brines, sold by producers in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	26.624	$503,452	1923	44,961	$663,384
1919	26,123	321,596	1924	58,791	1,164,848
1920	27,849	539,471	1925	67,870	1,386,639
1921	23,672	510,723	1926	82,340	1.710.405
1922	33,067	571,326	1927	95,721	1,947,797

Imports of calcium chloride have been as follows: 1927, 6,514 short tons, valued at $85,456; 1926, 7,372 tons, $96,742; 1925, 2,253 tons, $37,121; 1924, 3,996 tons, $54,542; 1923, 3,232 tons, $48,527. From September 22 to December 31, 1922, 740 tons, valued at $8,563, was imported. Similar imports were not separately recorded prior to change in tariff.

Exports of calcium chloride are not separately shown.

CARBON BLACK

Carbon black produced from natural gas in the United States, 1919–1927 [1]

Year	Number of producers reporting	Carbon black produced		Natural gas used (estimate)
		Pounds	Value at plant	M cubic feet
1919	17	52, 056, 941	$3, 816, 040	49, 896, 000
1920	19	51, 321, 892	4, 032, 286	40, 599, 000
1921	23	59, 766, 315	5, 445, 878	50, 565, 000
1922	26	67, 795, 129	5, 819, 618	53, 629, 000
1923	47	138, 262, 648	11, 692, 066	109, 096, 000
1924	46	186, 872, 034	11, 564, 936	156, 514, 000
1925	42	177, 417, 378	9, 639, 585	140, 366, 000
1926	33	180, 576, 176	9, 939, 221	130, 321, 000
1927	33	198, 429, 000	10, 955, 000	144, 087, 000

[1] Figures not available prior to 1919.

Imports of carbon black are not separately recorded. Exports were not separately recorded until 1925 when they were 43,182,635 pounds, valued at $3,555,769. Similar exports in 1926 were 39,210,389 pounds, valued at $3,622,907, and in 1927, 54,430,811 pounds, valued at $4,599,734.

CEMENT

Hydraulic cements shipped from mills in the United States, 1918–1927

Year	Masonry, natural, and puzzolan cements		Portland cement		Total	
	Barrels	Value	Barrels	Value	Barrels	Value
1918	432, 966	$401, 341	70, 915, 508	$113, 316, 275	71, 348, 474	$113, 717, 616
1919	528, 589	583, 554	85, 612, 899	146, 734, 844	86, 141, 488	147, 318, 398
1920	767, 481	1, 150, 890	96, 311, 719	194, 439, 025	97, 079, 200	195, 589, 915
1921	539, 402	897, 025	95, 507, 147	180, 778, 415	96, 046, 549	181, 675, 440
1922	889, 428	1, 293, 598	117, 701, 216	207, 170, 430	118, 590, 644	208, 464, 028
1923	1, 271, 674	1, 947, 352	135, 912, 118	257, 684, 424	137, 183, 792	259, 631, 776
1924	1, 418, 461	2, 006, 559	146, 047, 549	264, 046, 708	147, 466, 010	266, 053, 267
1925	1, 751, 725	2, 551, 583	157, 295, 212	278, 524, 108	159, 046, 937	281, 075, 691
1926	2, 031, 851	2, 820, 110	162, 187, 090	277, 965, 473	164, 218, 941	280, 785, 583
1927	2, 158, 323	2, 881, 029	171, 864, 728	278, 854, 647	174, 023, 051	281, 735, 676

Portland cement produced in the United States, 1918–1927, in barrels

1918	71, 081, 663	1923	137, 460, 238
1919	80, 777, 935	1924	149, 358, 109
1920	100, 023, 245	1925	161, 658, 901
1921	98, 842, 049	1926	164, 530, 170
1922	114, 789, 984	1927	173, 206, 513

Portland cement produced, shipped, and in stock in the United States, 1926 and 1927, by States and districts

	Production				Shipments				Stock at mills (Dec 31) (barrels)	
	Active plants		Barrels		1926		1927		1926	1927
	1926	1927	1926	1927	Barrels	Value	Barrels	Value		
STATE										
Alabama	5	6	6, 709, 829	7, 564, 863	6, 693, 900	$10, 825, 421	7, 313, 494	$10, 615, 428	403, 426	654, 795
California	11	12	13, 842, 483	14, 580, 654	13, 660, 078	25, 299, 245	14, 433, 153	26, 623, 396	662, 006	809, 507
Illinois	4	4	6, 747, 241	7, 017, 047	6, 977, 598	11, 388, 800	7, 061, 240	11, 312, 783	812, 468	768, 275
Iowa	4	5	4, 925, 811	5, 415, 144	4, 788, 639	8, 167, 341	5, 661, 234	9, 124, 405	1, 616, 842	1, 370, 752
Kansas	7	7	6, 357, 581	6, 180, 255	6, 150, 694	9, 757, 699	6, 141, 937	9, 939, 412	1, 099, 505	1, 137, 823
Michigan	16	15	12, 037, 400	13, 965, 241	11, 959, 447	19, 499, 788	13, 708, 259	20, 858, 202	1, 948, 302	2, 205, 284
Missouri	5	5	7, 653, 111	6, 778, 384	7, 639, 966	12, 917, 342	6, 929, 229	11, 117, 047	1, 097, 897	947, 052
New York	9	11	8, 795, 768	10, 775, 375	8, 535, 862	14, 864, 066	10, 531, 092	16, 380, 090	1, 284, 527	1, 528, 810
Ohio	10	10	7, 556, 493	8, 853, 869	7, 422, 720	12, 831, 503	8, 727, 879	14, 242, 901	1, 079, 385	1, 205, 375
Pennsylvania	23	25	42, 865, 694	43, 732, 278	41, 395, 604	70, 437, 218	42, 909, 513	66, 711, 069	4, 714, 827	5, 537, 592
Tennessee	4	5	5, 222, 114	4, 430, 439	5, 053, 528	8, 352, 095	4, 343, 337	6, 580, 732	429, 828	516, 930
Texas	6	7	5, 007, 374	5, 655, 835	5, 042, 359	9, 522, 701	5, 692, 350	10, 232, 908	443, 918	407, 403
Other States [1]	36	41	36, 809, 271	38, 257, 129	36, 866, 695	64, 102, 254	38, 412, 011	65, 116, 274	5, 147, 256	4, 992, 374
	140	153	164, 530, 170	173, 206, 513	162, 187, 090	277, 965, 473	171, 864, 728	278, 854, 647	20, 740, 187	22, 081, 972
DISTRICT										
Eastern Pennsylvania, New Jersey, and Maryland	23	24	42, 139, 204	42, 687, 200	40, 635, 514	69, 581, 973	41, 656, 489	64, 614, 336	4, 076, 535	5, 107, 246
New York	9	11	8, 795, 768	10, 775, 375	8, 535, 862	14, 864, 066	10, 531, 092	16, 380, 090	1, 284, 527	1, 528, 810
Ohio, western Pennsylvania, and West Virginia	15	18	15, 913, 500	17, 339, 199	15, 758, 822	26, 336, 705	17, 202, 341	27, 638, 726	2, 469, 740	2, 606, 598
Michigan	16	15	12, 037, 400	13, 965, 241	11, 959, 447	19, 499, 788	13, 708, 259	20, 858, 202	1, 948, 302	2, 205, 284
Wisconsin, Illinois, Indiana, and Kentucky	11	11	21, 350, 107	22, 022, 150	21, 876, 629	36, 267, 413	22, 394, 739	36, 274, 654	2, 986, 830	2, 614, 241
Virginia, Tennessee, Alabama, Georgia, Florida,[2] and Louisiana [3]	14	18	15, 307, 606	16, 016, 154	14, 963, 262	24, 860, 207	15, 530, 338	23, 668, 315	1, 196, 280	1, 682, 096
Eastern Missouri, Iowa, Minnesota, and South Dakota	10	11	14, 138, 619	14, 358, 201	14, 026, 247	23, 754, 460	14, 566, 818	23, 325, 158	2, 940, 185	2, 731, 568
Western Missouri, Nebraska, Kansas, and Oklahoma	11	11	10, 277, 391	10, 092, 888	10, 158, 484	16, 068, 802	10, 250, 532	16, 809, 793	1, 777, 409	1, 619, 765
Texas	6	7	5, 007, 374	5, 655, 835	5, 042, 359	9, 522, 701	5, 692, 350	10, 232, 908	443, 918	407, 403
Colorado, Montana, and Utah	7	8	2, 523, 509	2, 179, 241	2, 457, 303	5, 167, 446	2, 293, 514	4, 692, 136	483, 820	369, 547
California	11	12	13, 842, 483	14, 580, 654	13, 660, 078	25, 299, 245	14, 433, 153	26, 623, 396	662, 006	809, 507
Oregon and Washington	7	7	3, 197, 209	3, 534, 375	3, 113, 083	6, 742, 667	3, 605, 103	7, 736, 933	470, 635	399, 907
	140	153	164, 530, 170	173, 206, 513	162, 187, 090	277, 965, 473	171, 864, 728	278, 854, 647	20, 740, 187	22, 081, 972

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[1] 1926: Colorado, Georgia, Indiana, Kentucky, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, and Wisconsin; 1927: Same States as in 1926, with Florida and Louisiana in addition.

[2] Began producing in September, 1927; shipping in October, 1927.

[3] Louisiana began producing in June, 1927 shipping in July 1927.

Hydraulic cement imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Barrels	Value	Barrels	Value
1918	305	$1, 200	2, 252, 446	$5, 912, 166
1919	8, 931	52, 636	2, 463, 573	7, 513, 389
1920	524, 604	1, 254, 729	2, 985, 807	10, 045, 369
1921	122, 317	388, 842	1, 181, 014	4, 276, 986
1922	355, 931	692, 429	1, 127, 845	3, 206, 201
1923	1, 767, 264	3, 145, 977	1, 001, 688	2, 944, 174
1924	2, 023, 663	3, 139, 788	878, 543	2, 615, 154
1925	3, 667, 458	5, 836, 482	1, 019, 597	3, 003, 128
1926	3, 244, 223	5, 154, 926	974, 326	2, 995, 833
1927	2, 065, 730	3, 007, 103	816, 726	2, 796, 717

CHROMITE

Chromite shipped from mines in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	82, 430	$3, 955, 567	1923	227	$3, 819
1919	5, 079	129, 302	1924	288	1, 140
1920	2, 502	44, 857	1925	108	2, 105
1921	282	2, 900	1926	141	2, 079
1922	355	7, 288	1927	[1] 201	[1] 5, 063

[1] No shipments reported by producers to the Bureau of Mines for 1927. Division of Mines and Mining, Department of Natural Resources, California, reports 225 short tons, valued at $5,063 f. o. b. shipping point, as sold in 1927.

Crude chromite imported for consumption in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	100, 142	$2, 892, 825	1923	129, 693	$1, 123, 120
1919	61, 404	1, 381, 497	1924	118, 343	1, 095, 603
1920	150, 275	1, 921, 824	1925	149, 739	1, 207, 420
1921	81, 836	654, 602	1926	215, 464	1, 704, 947
1922	90, 081	741, 186	1927	222, 360	1, 748, 598

There are no exports of chromite.

CLAY

Clay sold by producers in the United States, 1918–1927

Year	Kaolin or china clay and paper clay		Ball clay		Slip clay		Fire clay	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	179, 694	$1, 459, 529	89, 896	$590, 631	13, 552	$49, 898	2, 305, 033	$5, 664, 064
1919	152, 828	1, 475, 681	65, 026	520, 849	5, 149	17, 556	1, 755, 331	4, 628, 605
1920	268, 203	2, 865, 407	69, 477	584, 611	9, 006	41, 519	2, 261, 915	7, 088, 049
1921	162, 726	1, 579, 163	54, 014	354, 565	4, 608	14, 841	1, 195, 861	3, 560, 373
1922	275, 675	2, 346, 095	76, 792	440, 877	4, 050	19, 405	1, 679, 220	4, 633, 486
1923	336, 803	2, 926, 255	97, 068	620, 978	8, 520	43, 609	2, 298, 163	6, 565, 899
1924	326, 611	2, 923, 965	83, 034	581, 966	5, 910	31, 023	2, 443, 710	6, 737, 063
1925	367, 319	3, 220, 719	109, 607	699, 427	7, 349	37, 397	2, 566, 934	7, 312, 349
1926	432, 215	3, 771, 568	112, 195	867, 500	8, 644	45, 959	2, 819, 346	8, 119, 323
1927	454, 245	3, 809, 834	119, 763	913, 976	6, 137	32, 264	2, 699, 761	7, 719, 725

Clay sold by producers in the United States, 1918–1927—Continued

Year	Stoneware clay		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	86, 800	$147, 098	301, 386	$421, 421	2, 976, 361	$8, 332, 641
1919	60, 236	80, 367	236, 530	367, 573	2, 275, 100	7, 090, 631
1920	106, 350	229, 221	322, 100	467, 856	3, 037, 051	11, 276, 663
1921	86, 574	184, 540	242, 963	361, 818	1, 746, 746	6, 055, 300
1922	86, 866	164, 870	525, 097	725, 781	2, 647, 700	8, 330, 514
1923	81, 389	194, 358	612, 717	837, 814	3, 434, 660	11, 188, 913
1924	59, 194	117, 142	772, 660	1, 116, 377	3, 691, 119	11, 507, 536
1925	77, 438	162, 161	901, 773	1, 304, 579	4, 030, 420	12, 736, 632
1926	84, 002	185, 288	510, 796	1, 115, 951	3, 967, 198	14, 105, 589
1927	98, 355	203, 648	470, 915	1, 017, 712	3, 849, 176	13, 697, 159

Clay imported for consumption in the United States, 1918–1927

Year	Kaolin or china clay		Common blue and Gross Almerode glass-pot clay		All other clays				Total	
					Unwrought		Wrought			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	168, 100	$1, 153, 240	114	$983	26, 984	$163, 484	137	$1, 087	195, 335	$1, 318, 794
1919	180, 592	1, 965, 393	4	133	23, 759	187, 550	498	4, 262	204, 853	2, 157, 338
1920	361, 800	3, 568, 677	6, 837	157, 201	34, 252	272, 524	691	10, 267	403, 580	4, 008, 669
1921	162, 906	1, 546, 285	4, 468	77, 217	41, 421	348, 870	120	2, 313	208, 915	1, 974, 685
1922	310, 136	2, 963, 420	7, 323	84, 415	40, 624	327, 388	2, 566	29, 398	360, 649	3, 404, 621
1923	311, 298	3, 046, 191	12, 999	121, 272	65, 379	481, 614	1, 676	21, 892	391, 352	3, 670, 969
1924	353, 124	3, 188, 454	7, 059	62, 883	82, 562	706, 018	1, 322	18, 685	444, 067	3, 976, 040
1925	372, 552	3, 195, 694	11, 889	107, 940	49, 991	499, 325	2, 383	29, 266	436, 815	3, 832, 225
1926	396, 219	3, 484, 054	6, 608	60, 391	84, 512	672, 223	2, 331	31, 243	489, 670	4, 247, 911
1927	339, 014	2, 937, 113	3, 884	39, 451	50, 017	447, 888	1, 585	24, 518	394, 500	3, 448, 970

Domestic clay exported from the United States, 1918–1927

Year	Fire clay		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	60, 206	$333, 880	24, 348	$192, 053	84, 554	$525, 933
1919	37, 486	262, 501	30, 983	249, 571	68, 469	512, 072
1920	54, 125	393, 177	66, 035	775, 222	120, 160	1, 168, 399
1921	23, 666	177, 979	23, 779	183, 449	47, 445	361, 428
1922	24, 391	169, 664	[1] 23, 285	[1] 267, 908	47, 676	437, 572
1923	50, 055	303, 675	34, 840	329, 192	84, 895	632, 867
1924	41, 704	312, 676	31, 051	420, 040	72, 755	732, 716
1925	44, 037	350, 571	39, 006	530, 995	83, 043	881, 566
1926	47, 737	348, 302	42, 157	644, 416	89, 894	992, 718
1927	48, 106	392, 327	51, 278	725, 562	99, 384	1, 117, 889

[1] Includes 2,091 short tons of "kaolin, china, and paper clay," valued at $27,840. Similar exports not shown separately for other years.

CLAY PRODUCTS

Value of clay products of the United States, 1918–1927 [1]

Year	Brick and tile	Pottery	Total	Year	Brick and tile	Pottery	Total
1918	$156, 661, 700	$63, 911, 793	$220, 573, 493	1923	$309, 631, 561	$114, 951, 067	$424, 582, 628
1919	197, 488, 616	77, 857, 762	275, 346, 378	1924	297, 764, 393	118, 014, 985	415, 779, 378
1920	266, 953, 426	106, 716, 676	373, 670, 102	1925	311, 428, 417	112, 018, 500	423, 446, 917
1921	186, 589, 507	84, 149, 029	270, 738, 536	1926	313, 935, 186	116, 493, 308	430, 428, 494
1922	[2] 229, 508, 106	91, 986, 297	[2] 321, 494, 403	1927	292, 322, 616	111, 612, 931	403, 935, 547

[1] Canvass discontinued by U. S. Geological Survey after 1920. Figures for 1921 to 1927 obtained through cooperation with Bureau of the Census.
[2] Includes value of "prepared clay," figures for which are not separately published.

Clay products of the United States, 1926 and 1927, by products [1]

Product	1926		1927	
	Quantity	Value	Quantity	Value
Common brick .... thousands	7, 517, 211	$88, 226, 625	7, 060, 984	$78, 407, 745
Vitrified brick or block .... do	467, 580	10, 284, 741	503, 400	10, 763, 724
Face brick .... do	2, 439, 820	44, 516, 236	2, 412, 903	41, 520, 881
Fancy or ornamental brick .... do	115	3, 592	1, 456	108, 451
Enameled brick .... do	15, 441	1, 275, 692	18, 097	1, 374, 725
Hollow brick .... do	63, 359	692, 258	37, 040	436, 065
Architectural terra cotta .... short tons	155, 564	19, 666, 880	155, 932	16, 628, 139
Fireproofing and hollow building tile .... do	4, 096, 417	27, 818, 428	4, 114, 309	26, 499, 380
Flue lining .... do	241, 465	2, 857, 309	252, 019	2, 851, 526
Tile (not drain)	....	34, 985, 194	....	32, 766, 412
Draintile .... short tons	519, 483	3, 858, 408	734, 392	5, 511, 301
Sewer pipe .... do	1, 994, 333	29, 303, 094	2, 115, 688	29, 425, 913
Stove lining .... do	11, 573	472, 904	13, 646	503, 021
Fire brick:				
Standard .... thousands	1, 016, 879	40, 992, 018	877, 748	35, 474, 393
Special shapes .... short tons	61, 909	1, 714, 914	132, 618	2, 699, 485
Glass-house tank blocks, melting pots, etc .... do	(2)	(2)	41, 177	2, 310, 473
Wall coping .... do	56, 345	685, 303	52, 841	670, 505
Miscellaneous	....	6, 581, 590	....	4, 370, 477
Total brick and tile	....	313, 935, 186	....	292, 322, 616
Total pottery	....	116, 493, 308	....	111, 612, 931
Grand total	....	430, 428, 494	....	403, 935, 547

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Included under "Miscellaneous"; not separately reported.

Value of clay products of the United States, 1926 and 1927, by States[1]

State	1926				1927			
	Number of firms reporting	Brick and tile	Pottery	Total	Number of firms reporting	Brick and tile	Pottery	Total
Alabama	40	$5,170,696	$10,875	$5,181,571	39	$4,823,670	(2)	[3] $4,823,670
Arizona	8	197,037	------------	197,037	8	345,391	------------	345,391
Arkansas	17	1,544,771	(2)	[3] 1,544,771	13	1,285,720	(2)	[3] 1,285,720
California	105	17,425,771	3,143,721	20,569,492	114	17,391,576	$3,602,914	20,994,490
Colorado	35	3,071,423	310,353	3,381,776	35	2,998,486	(2)	[3] 2,998,486
Connecticut	27	3,291,298	(2)	[3] 3,291,298	28	2,652,640	(2)	[3] 2,652,640
Delaware	6	156,897	------------	156,897	8	293,089	------------	293,089
District of Columbia	4	(2)	(2)	208,683	4	(2)	(2)	(2)
Florida	10	(2)	(2)	465,960	12	462,190	(2)	[3] 462,190
Georgia	35	5,957,486	(2)	[3] 5,957,486	40	4,853,932	25,804	4,879,736
Idaho	4	(2)	------------	(2)	6	205,993	------------	205,993
Illinois	142	31,417,593	5,612,411	37,030,004	127	29,319,507	5,133,098	34,452,605
Indiana	94	14,869,015	3,878,820	18,747,835	98	14,230,400	3,625,571	17,855,971
Iowa	51	4,459,724	(2)	[3] 4,459,724	53	5,158,104	(2)	[3] 5,158,104
Kansas	29	(2)	(2)	3,969,040	30	3,805,509	(2)	[3] 3,805,509
Kentucky	49	7,428,678	248,180	7,676,858	44	7,257,664	(2)	[3] 7,257,664
Louisiana	16	(2)	(2)	682,307	14	446,156	(2)	[3] 446,156
Maine	19	(2)	------------	(2)	16	680,739	------------	680,739
Maryland	30	2,893,860	3,179,387	6,073,247	26	2,503,935	(2)	[3] 2,503,935
Massachusetts	42	2,675,526	1,296,060	3,971,586	40	2,398,474	(2)	[3] 2,398,474
Michigan	42	4,227,731	3,134,276	7,362,007	39	3,892,646	2,879,637	6,772,283
Minnesota	27	1,852,566	(2)	[3] 1,852,566	24	1,675,662	(2)	[3] 1,675,662
Mississippi	23	1,006,661	(2)	[3] 1,006,661	24	1,146,472	(2)	[3] 1,146,472
Missouri	66	17,562,247	56,684	17,618,931	57	16,322,322	69,849	16,392,171
Montana	11	273,121	------------	273,121	9	299,622	------------	299,622
Nebraska	24	1,112,923	(2)	[3] 1,112,923	19	819,494	(2)	[3] 819,494
Nevada	1	(2)	------------	(2)	1	(2)	------------	(2)
New Hampshire	12	881,997	------------	881,997	12	811,626	------------	811,626
New Jersey	126	23,046,186	24,466,328	47,512,514	123	20,370,048	22,729,721	43,099,769
New Mexico	4	(2)	------------	(2)	4	161,666	------------	161,666
New York	124	21,494,016	7,505,037	28,999,053	114	17,820,424	7,656,472	25,476,896
North Carolina	77	4,225,653	31,248	4,256,901	72	3,833,258	27,692	3,860,950
North Dakota	4	(2)	------------	(2)	4	130,733	------------	130,733
Ohio	380	56,855,563	41,017,539	97,873,102	372	53,856,958	38,738,172	92,595,130
Oklahoma	20	1,504,744	------------	1,504,744	19	1,693,669	------------	1,693,669
Oregon	20	(2)	(2)	(2)	21	656,563	(2)	[3] 656,563
Pennsylvania	309	46,558,926	8,482,344	55,041,270	286	42,749,157	8,239,664	50,988,821
Rhode Island	1	(2)	------------	(2)	1	(2)	------------	(2)
South Carolina	26	1,869,420	(2)	[3] 1,869,420	24	1,802,772	(2)	[3] 1,802,772
South Dakota	1	(2)	------------	(2)	------	------------	------------	------------
Tennessee	43	4,201,783	904,044	5,105,827	35	3,728,380	(2)	[3] 3,728,380
Texas	70	5,814,913	196,068	6,010,981	67	6,219,094	197,923	6,417,017
Utah	13	929,782	(2)	[3] 929,782	12	1,024,559	(2)	[3] 1,024,559
Vermont	3	(2)	------------	(2)	2	(2)	------------	(2)
Virginia	50	3,755,980	(2)	[3] 3,755,980	47	2,932,998	(2)	[3] 2,932,998
Washington	34	2,557,967	25,366	2,583,333	35	2,465,723	52,527	2,518,250
West Virginia	51	5,182,626	10,938,546	16,121,172	48	4,895,461	11,424,912	16,320,373
Wisconsin	34	(2)	(2)	(2)	36	1,228,338	(2)	[3] 1,228,338
Wyoming	3	(2)	------------	(2)	4	101,708	------------	101,708
Undistributed	------	8,460,606	2,056,021	5,190,637	------	570,088	7,208,975	7,779,063
	2,362	313,935,186	116,493,308	430,428,494	2,266	292,322,616	111,612,931	403,935,547

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[1] Figures obtained through cooperation with Bureau of the Census.

[2] Included under "Undistributed."

[3] Exclusive of pottery, value for which is included under "Undistributed."

Value of clay products imported for consumption in the United States, 1918–1927

Year	Pottery								Brick, fire brick, tile, and miscellaneous clay products	Grand total
	Brown earthen and common stone ware [1]	Tobacco pipes and pipe bowls of clay	Earthenware and crockery composed of a nonvitrified absorbent body		China and porcelain		Sanitary earthenware, decorated and not decorated	Total		
			Not decorated	Decorated	Not decorated	Decorated				
1918	$436, 207	$4, 716	$317, 501	$2, 147, 486	$200, 328	$3, 269, 008	$18, 334	$6, 393, 580	$290, 620	$6, 684, 200
1919	293, 120	15, 852	350, 644	2, 476, 210	359, 560	3, 726, 695	7, 980	7, 230, 061	196, 839	7, 426, 900
1920	390, 962	12, 091	340, 676	3, 805, 955	431, 636	5, 856, 384	13, 068	10, 850, 772	252, 656	11, 103, 428
1921	288, 893	11, 535	405, 370	3, 871, 554	646, 427	6, 918, 179	12, 067	12, 154, 025	228, 804	12, 382, 829
1922	341, 997	15, 638	339, 066	4, 427, 001	641, 261	6, 298, 440	17, 295	12, 080, 698	375, 764	12, 456, 462
1923	263, 388	26, 606	881, 480	4, 916, 906	864, 239	8, 830, 266	346, 589	16, 129, 474	864, 124	16, 993, 598
1924	314, 721	14, 517	765, 070	5, 041, 570	799, 772	9, 504, 905	125, 100	16, 565, 655	690, 639	17, 256, 294
1925	401, 421	22, 385	544, 124	5, 679, 094	699, 792	9, 994, 062	5, 463	17, 346, 341	935, 507	18, 281, 848
1926	359, 951	21, 661	445, 436	6, 444, 433	623, 360	11, 383, 666	1, 873	19, 280, 380	1,939,843	21, 220, 223
1927	209, 736	10, 327	458, 141	7, 320, 731	578, 499	11, 875, 202	4, 950	20, 457, 586	1,849,355	22, 306, 941

[1] Including Rockingham ware and miscellaneous pottery products.

Value of clay products of domestic manufacture exported from the United States, 1918–1927

Year	Building brick	Fire brick	Tile (except drain)	Earthen and stone ware	China	Sanitary earthenware	All other	Total
1918	$117, 263	$5, 001, 057	$582, 051	$783, 577	$318, 448	$377, 527	$752, 651	$7, 932, 574
1919	248, 690	2, 747, 512	628, 836	1, 148, 051	523, 861	563, 734	721, 600	6, 582, 284
1920	382, 814	4, 200, 266	1, 025, 083	1, 241, 938	816, 817	778, 714	951, 991	9, 397, 623
1921	415, 402	2, 314. 911	814, 456	1, 014, 329	312, 161	535, 506	873, 182	6, 279, 947
1922	210, 215	1, 581, 679	390, 408	981, 082	316, 973	561, 536	[1] 1, 599, 949	5, 641, 842
1923	282, 454	2, 332, 536	373, 866	932, 779	334, 146	657, 859	[1] 1, 915, 842	6, 829, 482
1924	222, 033	1, 463, 412	400, 452	753, 652	259, 098	745, 746	[1] 1, 863, 324	5, 707, 717
1925	194, 153	1, 323, 128	396. 088	758, 883	255, 578	788, 528	[1] 1, 041, 484	4, 757, 842
1926	176, 711	1, 406, 809	376, 162	694, 736	268, 796	1, 026, 636	[1] 1, 691, 131	5, 640, 981
1927	161, 346	3, 024, 156	391, 190	862, 396	338, 955	1, 198, 660	[1] 1, 310, 338	7, 287, 041

[1] Includes electric porcelain valued at $1,379,750 in 1922, $1,783,614 in 1923, $1,767,323 in 1924, $949,785 in 1925, $1,541,675 in 1926, and $1,201,481 in 1927; not separately classified prior to 1922.

COAL

Coal produced in the United States, 1918–1927

Year	Pennsylvania anthracite		Bituminous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	98, 826, 084	$336, 480, 347	579, 385, 820	$1, 491, 809, 940	678, 211, 904	$1, 828, 290, 287
1919	88, 092, 201	364, 926, 950	465. 860, 058	1, 160, 616, 013	553, 952, 259	1, 525, 542, 963
1920	89, 598, 249	434, 252, 198	568, 666, 683	2, 129, 933, 000	658, 264, 932	2, 564, 185. 000
1921	90, 473, 451	452, 304, 903	415, 921, 950	1, 199, 983, 600	506, 395, 401	1, 652, 288, 600
1922	54, 683, 022	273, 700, 125	422, 268, 099	1, 274, 820, 000	476, 951, 121	1, 548, 520, 000
1923	93, 339, 009	506, 786, 768	564, 564, 662	1, 514, 621, 000	657, 903, 671	2. 021. 408, 000
1924	87, 926, 862	477, 230, 852	483, 686, 538	1, 062, 626, 000	571, 613, 400	1, 539. 857, 000
1925	61, 817, 149	327, 664, 512	520, 052, 741	1, 060, 402, 000	581, 869, 890	1, 388, 067, 000
1926	84, 437, 452	474, 164, 252	573, 366, 985	1, 183, 412, 000	657, 804, 437	1, 657, 576, 000
1927	80, 095, 564	420, 941, 726	517, 763, 352	1, 029, 657, 000	597. 858, 916	1, 450, 599, 000

Coal produced in the United States, 1926 and 1927, by States

[Exclusive of product of wagon mines]

State	1926		1927	
	Short tons	Value	Short tons	Value
Alabama	21, 000, 962	$48, 036, 000	19, 765, 866	$44, 524, 000
Alaska	87, 300	459, 000	104, 300	548, 000
Arizona	624	1, 000	4, 583	6, 000
Arkansas	1, 459, 017	5, 497, 000	1, 548, 834	5, 393, 000
California, Idaho, Nevada,[1] and Oregon	18, 708	70, 000	27, 841	85, 000
Colorado	10, 637, 225	29, 529, 000	9, 724, 075	27, 044, 000
Georgia	59, 869	173, 000	76, 712	233, 000
Illinois	69, 366, 923	148, 604, 000	46, 848, 224	101, 356, 000
Indiana	23, 186, 006	45, 889, 000	17, 935, 758	36, 381, 000
Iowa	4, 625, 487	14, 214, 000	2, 949, 622	9, 304, 000
Kansas	4, 416, 480	12, 535, 000	3, 443, 762	9, 648, 000
Kentucky	62, 924, 462	109, 740, 000	69, 123, 998	119, 249, 000
Maryland	3, 078, 353	6, 800, 000	2, 814, 842	5, 817, 000
Michigan	686, 707	2, 829, 000	756, 763	3, 262, 000
Missouri	3, 008, 495	8, 951, 000	3, 064, 343	8, 698, 000
Montana	2, 797, 760	6, 883, 000	3, 143, 638	7, 403, 000
New Mexico	2, 817, 923	8, 916, 000	2, 935, 539	9, 179, 000
North Carolina	57, 939	243, 000	53, 377	191, 000
North Dakota	1, 370, 244	2, 378, 000	1, 527, 939	2, 604, 000
Ohio	27, 872, 488	54, 759, 000	15, 799, 697	30, 376, 000
Oklahoma	2, 842, 673	9, 042, 000	3, 818, 054	11, 570, 000
Pennsylvania (bituminous)	153, 041, 638	325, 618, 000	132, 964, 639	272, 714, 000
South Dakota	14, 428	42, 000	12, 507	38, 000
Tennessee	5, 788, 741	10, 975, 000	5, 783, 367	10, 645, 000
Texas	1, 091, 158	1, 751, 000	1, 326, 385	1, 998, 000
Utah	4, 373, 793	10, 362, 000	4, 781, 480	11, 084, 000
Virginia	14, 133, 386	27, 203, 000	12, 916, 042	23, 203, 000
Washington	2, 586, 568	9, 350, 000	2, 635, 062	9, 222, 000
West Virginia	143, 509, 340	264, 736, 000	145, 122, 447	249, 730, 000
Wyoming	6, 512, 288	17, 827, 000	6, 753, 656	18, 152, 000
Total bituminous	573, 366, 985	1, 183, 412, 000	517, 763, 352	1, 029, 657, 000
Pennsylvania anthracite	84, 437, 452	474, 164, 252	80, 095, 564	420, 941, 726
Grand total	657, 804, 437	1, 657, 576, 000	597, 858, 916	1, 450, 599, 000

[1] Production reported from Nevada for 1927 only.

Coal produced in the United States, 1926 and 1927, by months, in short tons

Month	Pennsylvania anthracite		Bituminous	
	1926	1927	1926	1927
January	172, 000	6, 516, 000	53, 205, 000	56, 660, 000
February	2, 069, 000	5, 812, 000	46, 180, 000	52, 697, 000
March	8, 732, 000	6, 056, 000	45, 744, 000	59, 911, 000
April	8, 163, 000	7, 078, 000	39, 738, 000	34, 538, 000
May	8, 001, 000	7, 947, 000	38, 727, 000	35, 256, 000
June	8, 878, 000	7, 207, 000	41, 635, 000	36, 483, 000
July	8, 371, 000	4, 993, 000	43, 102, 000	33, 505, 000
August	8, 171, 000	7, 694, 000	45, 957, 000	41, 541, 000
September	8, 388, 000	6, 596, 000	48, 559, 000	41, 763, 000
October	8, 617, 000	7, 353, 000	54, 127, 000	43, 827, 000
November	7, 397, 000	6, 854, 000	59, 213, 000	40, 468, 000
December	7, 478, 000	5, 990, 000	57, 180, 000	41, 114, 000
	84, 437, 000	80, 096, 000	573, 367, 000	517, 763, 000

Coal imported for consumption in the United States, 1918–1927

Year	Anthracite		Bituminous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	37,272	$204,385	1,457,073	$6,694,081	1,494,345	$6,898,466
1919	82,818	522,419	1,011,550	4,950,686	1,094,368	5,473,105
1920	31,748	257,835	1,244,990	6,733,676	1,276,738	6,991,511
1921	8,894	93,103	1,257,589	7,363,945	1,266,483	7,457,048
1922	233,528	1,502,192	5,059,999	26,747,374	5,293,527	28,249,566
1923	300,360	2,114,080	1,881,465	10,128,516	2,181,825	12,242,596
1924	117,914	880,364	416,736	2,135,402	534,650	3,015,766
1925	382,894	3,212,505	601,737	2,633,980	984,631	5,846,485
1926	813,956	6,996,739	485,298	2,300,570	1,299,254	9,297,309
1927	119,030	837,033	548,278	2,435,212	667,308	3,272,245

Coal exported from the United States, 1918–1927

Year	Anthracite		Bituminous [1]		Total [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	4,967,808	$29,215,689	22,350,730	$78,664,856	27,318,538	$107,880,545
1919	4,976,598	36,668,131	20,113,536	83,708,842	25,090,134	120,376,973
1920	5,403,749	45,538,100	38,517,084	304,273,241	43,920,833	349,811,341
1921	4,677,368	45,624,555	23,131,166	122,597,038	27,808,534	168,221,593
1922	2,649,457	25,350,677	12,413,085	65,891,740	15,062,542	91,242,417
1923	5,090,138	49,577,339	21,453,579	104,546,585	26,543,717	154,123,924
1924	4,017,785	40,067,804	17,100,347	70,971,302	21,118,132	111,039,106
1925	3,179,006	31,760,627	17,461,560	68,402,668	20,640,566	100,163,295
1926	4,029,683	41,085,946	35,271,937	155,818,572	39,301,620	196,904,518
1927	3,325,507	32,927,796	18,011,744	71,328,924	21,337,251	104,256,720

[1] Exclusive of bunker coal, which has been as follows: 1918, 6,196,036 short tons, valued at $29,868,023; 1919, 8,223,862 tons, $48,205,675; 1920, 10,485,639 tons, $82,461,518; 1921, 8,453,220 tons, $52,277,668; 1922, 4,614,632 tons, $27,912,957; 1923, 5,093,024 tons, $31,469,788; 1924, 4,460,412 tons, $22,883,293; 1925, 4,865,521 tons, $23,397,831; 1926, 7,735,606 tons, $38,025,411; 1927, 4,565,278 tons, $22,077,203.

COBALT

No cobalt ores are known to have been produced in the United States in 1922 to 1927. Production in other years of the decade 1918 to 1927 has been as follows: 1918, 4,000 short tons of cobalt ores, mined in Idaho, were reduced to 55 tons of concentrates carrying 17.74 per cent of cobalt (19,514 pounds); 1919, concentrates carrying approximately 18 per cent of cobalt were produced in Idaho, and cobalt oxide mined and reduced near Fredericktown, Mo., contained 28 pounds of cobalt, valued at $122,452; 1920, 102,410 pounds of cobalt in oxide and hydrate, valued at $262,801, was recovered from ore mined near Fredericktown, Mo.; 1921, 42,086 pounds of heterogenite (cobalt oxide), containing 4,018 pounds of cobalt, was mined near Goodsprings, Nev.; it was shipped in 1922 and sold for $1,419.

Cobalt ore, cobalt, and oxide imported for consumption in the United States, 1918–1927

Year	Ore		Cobalt		Oxide		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1918	(1)	(1)	504, 391	$628, 099	208, 596	$291, 699	712, 987	$919, 798
1919	17, 045	$2, 832	60, 511	141, 450	131, 424	184, 751	208, 980	329, 033
1920	13, 039	4, 794	143, 603	326, 864	202, 724	399, 605	[2] 359, 586	[2] 731, 277
1921	7, 657	3, 235	38, 442	105, 539	164, 003	342, 426	210, 102	451, 200
1922	5, 195	7, 075	126, 364	321, 396	217, 530	435, 895	[3] 349, 089	[3] 764, 366
1923	58, 719	56, 326	225, 639	552, 434	258, 574	511, 903	[3] 542, 932	[3] 1, 120, 663
1924	28, 786	37, 276	118, 952	264, 935	226, 703	440, 898	[3] 374, 441	[3] 743, 109
1925	34, 782	31, 320	198, 669	422, 185	287, 265	546, 292	[3] 520, 716	[3] 999, 797
1926	154, 468	55, 820	387, 076	820, 873	333, 132	632, 478	[2, 3] 874, 786	[2, 3] 1, 509, 211
1927	60, 382	3, 019	407, 198	841, 442	369, 747	703, 608	[3] 837, 327	[3] 1, 548, 069

[1] Ore included with cobalt; not separately recorded until July, 1918. From July to December, 1918, imports are recorded as follows: Ore, 220,115 pounds, valued at $55,188; metal, 250,920 pounds, valued at $498,316.

[2] Includes 220 pounds of zaffer, valued at $14, in 1920, and 110 pounds, valued at $40, in 1926. Imports of zaffer not separately recorded for 1918, and none imported 1919, 1921 to 1925, and 1927.

[3] Also 11 pounds of "other salts and compounds," valued at $26, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff. Similar additional imports in 1923 were 45,644 pounds, valued at $27,356; in 1924, 797 pounds, $856; in 1925, 13,256 pounds, $7,894; in 1926, 37,342 pounds, $21,647; and in 1927, 55,127 pounds, $28,681.

COKE AND COKE-OVEN BY-PRODUCTS

COKE

Coke produced in the United States, 1918–1927

Year	Beehive		By-product		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	30, 480, 792	$189, 305, 583	25, 997, 580	$193, 018, 785	56, 478, 372	$382, 324, 368
1919	19, 042, 936	98, 094, 972	25, 137, 621	160, 244, 768	44, 180, 557	258, 339, 740
1920	20, 511, 092	162, 952, 483	30, 833, 951	313, 028, 732	51, 345, 043	475, 981, 215
1921	5, 538, 042	30, 166, 449	19, 749, 580	117, 506, 646	25, 287, 622	147, 673, 095
1922	8, 573, 467	50, 036, 556	28, 550, 545	188, 276, 767	37, 124, 012	238, 313, 323
1923	19, 379, 870	115, 905, 580	37, 597, 664	257, 591, 318	56, 977, 534	373, 496, 898
1924	10, 286, 037	48, 351, 552	33, 983, 568	195, 690, 009	44, 269, 605	244, 041, 561
1925	11, 354, 784	51, 731, 566	39, 912, 159	210, 827, 571	51, 266, 943	262, 559, 137
1926	12, 488, 951	57, 024, 869	44, 376, 586	250, 748, 533	56, 865, 537	307, 773, 402
1927	7, 207, 417	30, 276, 775	43, 884, 726	232, 043, 803	51, 092, 143	262, 320, 578

Coke produced in the United States, 1926 and 1927, by States

State	1926		1927	
	Short tons	Value [1]	Short tons	Value [1]
Alabama	(2)	(2)	4,364,354	$13,500,234
Colorado	790,118	(3)	788,586	(3)
Georgia	3,059	$23,034	(2)	(2)
Illinois	3,336,962	25,050,474	3,013,940	21,076,519
Indiana	5,990,344	44,143,059	5,549,762	37,152,981
Kentucky	(2)	(2)	(2)	(2)
Maryland	1,120,610	(3)	1,077,309	(3)
Massachusetts	573,748	(3)	744,091	6,008,556
Michigan	1,826,638	12,713,083	1,920,394	12,227,241
Minnesota	619,905	6,014,738	632,628	6,212,501
Missouri	(2)	(2)	(2)	(2)
New Jersey	913,250	(3)	906,321	(3)
New Mexico	(2)	(2)		
New York	2,827,805	17,455,226	3,602,642	24,125,451
Ohio	7,632,806	(3)	(2)	(2)
Pennsylvania	21,922,976	96,318,119	16,777,291	67,170,075
Rhode Island	(2)	(2)	(2)	(2)
Tennessee	241,034	1,233,499	227,120	1,149,604
Utah	306,231	(3)	282,048	(3)
Virginia	370,983	1,716,716	316,754	1,413,595
Washington	67,286	518,053	71,271	530,759
West Virginia	1,713,461	6,918,103	1,923,427	6,840,358
Wisconsin	(2)	(2)	(2)	(2)
Combined States	6,608,321	29,775,733	8,894,205	46,626,817
Undistributed		65,893,565		18,285,887
	56,865,537	307,773,402	51,092,143	262,320,578

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[1] Includes operators' statements of value for that portion of product not sold (such as coke consumed by producer in associated iron furnaces).

[2] Included under "Combined States."

[3] Included under "Undistributed."

Coke produced in the United States, 1926 and 1927, by States and kinds

State	Beehive				By-product			
	1926		1927		1926		1927	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)			4,779,986	$16,823,492	4,364,354	$13,500,234
Colorado	197,179	(2)	194,184	(2)	592,939	(2)	594,402	(2)
Georgia	3,059	$23,034	(1)	(1)				
Illinois					3,336,962	25,050,474	3,013,940	21,076,519
Indiana					5,990,344	44,143,059	5,549,762	37,152,981
Kentucky	147,540	600,169	(1)	(1)	(1)	(1)	(1)	(1)
Maryland					1,120,610	(2)	1,077,309	(2)
Massachusetts					573,748	(2)	744,091	6,008,556
Michigan					1,826,638	12,713,083	1,920,394	12,227,241
Minnesota					619,905	6,014,738	632,628	6,212,501
Missouri					(1)	(1)	(1)	(1)
New Jersey					913,250	(2)	906,321	(2)
New Mexico	(1)	(1)						
New York					2,827,805	17,455,226	3,602,642	24,125,451
Ohio	84,970	(2)	(1)	(1)	7,547,836	40,344,524	7,213,619	34,684,465
Pennsylvania	10,722,352	47,595,184	5,716,207	$22,568,318	11,200,624	48,722,935	11,061,084	44,601,757
Rhode Island					(1)	(1)	(1)	(1)
Tennessee	122,410	605,017	104,808	536,821	118,624	628,482	122,312	612,783
Utah	121,475	1,033,284	84,865	(2)	184,756	(2)	197,183	(2)
Virginia	370,983	1,716,716	316,754	1,413,595				
Washington	24,702	214,429	30,701	246,769	42,584	303,624	40,570	283,990
West Virginia	583,599	2,652,219	527,142	2,161,310	1,129,862	4,265,884	1,396,285	4,679,048
Wisconsin					(1)	(1)	(1)	(1)
Combined States	110,682	730,590	232,756	1,317,756	1,570,113	11,621,482	1,447,830	10,624,596
Undistributed		1,854,227		2,032,206		22,661,530		16,253,681
	12,488,951	57,024,869	7,207,417	30,276,775	44,376,586	250,748,533	43,884,726	232,043,803

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[1] Included under "Combined States."

[2] Included under "Undistributed."

Coke produced in the United States, 1926 and 1927, by months, in short tons

Month	1926			1927		
	Beehive	By-product	Total	Beehive	By-product	Total
January	1, 500, 000	3, 796, 000	5, 296, 000	810, 000	3, 706, 000	4, 516, 000
February	1, 524, 000	3, 492, 000	5, 016, 000	776, 000	3, 429, 000	4, 205, 000
March	1, 259, 000	3, 772, 000	5, 031, 000	916, 000	3, 876, 000	4, 792, 000
April	1, 068, 000	3, 604, 000	4, 672, 000	802, 000	3, 705, 000	4, 507, 000
May	964, 000	3, 725, 000	4, 689, 000	648, 000	3, 785, 000	4, 433, 000
June	882, 000	3, 614, 000	4, 496, 000	596, 000	3, 594, 000	4, 190, 000
July	856, 000	3, 771, 000	4, 627, 000	480, 000	3, 655, 000	4, 135, 000
August	818, 000	3, 742, 000	4, 560, 000	500, 000	3, 677, 000	4, 177, 000
September	892, 000	3, 640, 000	4, 532, 000	470, 000	3, 601, 000	4, 071, 000
October	943, 000	3, 799, 000	4, 742, 000	431, 000	3, 717, 000	4, 148, 000
November	935, 000	3, 730, 000	4, 665, 000	390, 000	3, 497, 000	3, 887, 000
December	848, 000	3, 692, 000	4, 540, 000	388, 000	3, 643, 000	4, 031, 000
	12, 489, 000	44, 377, 000	56, 866, 000	7, 207, 000	43, 885, 000	51, 092, 000

Coke imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1918	30, 168	$221, 880	1, 687, 824	$11, 861, 408
1919	16, 486	140, 653	716, 956	5, 128, 119
1920	41, 143	403, 175	919, 802	9, 993, 665
1921	30, 990	336, 394	306, 755	2, 760, 939
1922	94, 228	802, 987	511, 541	4, 319, 538
1923	85, 002	862, 596	1, 237, 342	11, 889, 897
1924	82, 833	795, 477	659, 350	4, 926, 478
1925	201, 579	1, 609, 474	953, 812	6, 871, 962
1926	284, 548	2, 174, 350	987, 260	6, 979, 896
1927	168, 859	1, 371, 568	806, 664	5, 430, 704

COKE-OVEN BY-PRODUCTS

By-products from coke-oven operations in the United States, 1926 and 1927

Product	Produced	Sold	
		Quantity	Value
1926			
Tar……gallons..	529, 486, 374	277, 248, 522	$14, 103, 760
Ammonia:			
Sulphate……pounds..	1, 167, 859, 453	1, 152, 141, 717	24, 658, 031
Ammonia liquor (NH_3 content)……do....	53, 523, 229	53, 448, 034	3, 470, 172
Sulphate equivalent of all forms……do....	(1, 381, 952, 369)	(1, 365, 933, 853)	28, 128, 203
Gas:			
Distributed through city mains……M cu. ft..	[1] 706, 681, 828	89, 565, 953	29, 978, 997
Used in steel or affiliated plant……do....		249, 840, 649	27, 955, 574
Used under boilers, etc……do....		25, 953, 876	1, 438, 699
Sold for industrial use……do....		32, 553, 610	5, 313, 530
			64, 686, 800
Light oil and derivatives:			
Crude light oil……gallons..	[2] 164, 059, 552	10, 783, 568	1, 330, 208
Benzol, crude……do....	4, 744, 713	4, 660, 621	1, 109, 974
Benzol, refined……do....	17, 713, 904	17, 327, 169	3, 957, 719
Motor benzol……do....	90, 029, 972	89, 501, 212	16, 863, 109
Toluol, crude……do....	432, 317	400, 308	127, 298
Toluol, refined……do....	8, 359, 135	8, 250, 297	2, 787, 454
Solvent naphtha……do....	4, 704, 555	3, 546, 117	1, 035, 870
Other light-oil products……do....	4, 127, 710	1, 324, 303	93, 344
			27, 304, 976
Naphthalene, crude……pounds..	7, 746, 821	7, 556, 372	96, 210
Naphthalene, refined……do....	139, 701	166, 851	1, 100
			97, 310
Other products……	……	……	148, 720
	……	……	[3] 134, 469, 769
1927			
Tar……gallons..	546, 859, 205	305, 898, 176	16, 095, 478
Ammonia:			
Sulphate……pounds..	1, 216, 141, 460	1, 267, 753, 969	24, 802, 926
Ammonia liquor (NH_3 content)……do....	54, 694, 723	53, 994, 327	2, 580, 342
Sulphate equivalent of all forms……do....	(1, 434, 920, 352)	(1, 483, 731, 277)	27, 383, 268
Gas:			
Distributed through city mains……M cu. ft..	[1] 700, 894, 799	106, 910, 108	36, 249, 081
Used in steel or affiliated plant……do....		244, 969, 339	26, 580, 340
Used under boilers, etc……do....		25, 848, 762	1, 866, 342
Sold for industrial use……do....		30, 661, 148	5, 396, 405
			70, 092, 168
Light oil and derivatives:			
Crude light oil……gallons..	[2] 164, 488, 233	9, 265, 948	1, 077, 957
Benzol, crude and refined……do....	22, 007, 760	21, 193, 807	4, 371, 519
Motor benzol……do....	86, 995, 343	86, 802, 745	14, 629, 999
Toluol, crude and refined……do....	12, 093, 590	11, 784, 984	3, 999, 820
Solvent naphtha……do....	4, 979, 736	3, 661, 970	926, 787
Other light-oil products……do....	3, 155, 031	1, 393, 876	147, 017
			25, 153, 099
Naphthalene, crude……pounds..	8, 302, 845	7, 848, 224	86, 078
Other products……	……	……	93, 791
	……	……	[3] 138, 903, 882

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[1] Inclusive of gas wasted and gas used for heating retorts.

[2] Of the crude light oil, 159,589,756 gallons in 1926 and 161,072,729 gallons in 1927 was refined on the premises to make the derived products listed.

[3] Exclusive of value of coke breeze.

COLUMBITE

[See Tantalum]

COPPER [1]

Summary of statistics of the copper industry in the United States, 1925–1927

	1925	1926	1927
Production of copper:			
Smelter output from domestic ores ....pounds..	1,674,869,886	1,739,622,094	1,684,040,983
Mine production ....do....	1,678,117,747	1,725,275,931	1,649,959,370
Refinery production of new copper—			
Electrolytic ....do....	1,533,995,439	1,553,041,424	1,520,076,181
Lake ....do....	138,029,764	172,372,304	195,135,199
Casting ....do....	10,870,144	5,883,433	3,740,819
Total domestic ....do....	1,682,895,347	1,731,297,161	1,718,952,199
Total domestic and foreign ....do....	2,204,573,824	2,322,485,376	2,325,763,709
Total new and old copper ....do....	3,045,000,000	3,282,000,000	3,306,000,000
Ore produced:			
Copper ore ....short tons..	53,103,014	57,181,894	56,725,460
Average yield of copper ....per cent..	1.54	1.46	1.41
Copper-lead and copper-lead-zinc ores..short tons..	228,612	282,015	418,601
Average price per pound ....cents..	14.2	14.0	13.1
General imports (unmanufactured) ....pounds..	652,971,407	779,441,803	718,322,990
Exports of metallic copper [2] ....do....	1,082,369,439	960,220,112	1,069,493,121
Withdrawn from total supply on domestic account:			
Total new copper ....pounds..	1,401,012,091	1,570,136,207	1,422,959,219
Total new and old copper ....do....	2,241,000,000	2,530,000,000	2,403,000,000
Stocks at end of year:			
Refined copper ....do....	124,000,000	146,000,000	171,000,000
Blister and material in solution ....do....	432,000,000	455,000,000	401,000,000
World production (smelter) ....do....	3,093,085,000	3,214,339,000	3,333,388,000
Value of smelter production from domestic ores	$237,832,000	$243,547,000	$220,609,000

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[1] For prices of copper, see statement on p. A11.

[2] Total exports of copper, exclusive of ore, concentrates, composition metal, and of unrefined copper for which figures are not separable from those for ore and concentrates. In 1926 and 1927 exclusive also of "Other manufactures of copper" for which figures for quantity are not recorded.

Copper produced in the United States from domestic ores, 1918–1927

[Smelter output, in pounds fine]

Year	Pounds	Value	Year	Pounds	Value
1918	1,908,533,595	$471,408,000	1923	1,434,999,962	$210,945,000
1919	1,286,419,329	239,274,000	1924	1,634,249,192	214,087,000
1920	1,209,061,040	222,467,000	1925	1,674,869,886	237,832,000
1921	505,586,098	65,221,000	1926	1,739,622,094	243,547,000
1922	950,285,947	128,289,000	1927	1,684,040,983	220,609,000

Copper produced in the United States from domestic ores, 1923–1927, by States

[Smelter output, in pounds fine]

State	1923	1924	1925	1926	1927
Alaska	68,648,368	77,053,492	72,204,166	67,631,846	56,489,214
Arizona	615,493,561	672,365,115	722,653,457	729,324,537	681,168,117
California	27,042,835	49,433,716	46,943,604	30,442,961	25,802,603
Colorado	4,343,418	4,158,612	3,163,211	4,657,591	8,006,801
Idaho	3,664,079	3,148,519	3,144,064	1,171,262	1,811,103
Michigan	137,691,306	145,333,227	138,029,764	174,778,884	195,135,199
Missouri	217,449	184,947	12,114	54,378	5,041
Montana	224,353,764	249,322,394	270,604,676	257,271,936	225,208,853
Nevada	63,495,928	77,281,479	77,137,563	109,041,769	118,298,342
New Mexico	57,521,171	78,145,629	76,467,245	82,848,096	79,761,222
North Carolina	61,913	....	....	1,468,746	5,362,041
Oregon	1,182,437	716,656	126,107	279,223	484,652
Pennsylvania	1,121,573	1,263,535	562,240	495,698	2,149,182
Tennessee	18,721,932	18,251,996	19,789,234	18,601,586	14,498,951
Texas	4,216	302	785	17,102	25,460
Utah	210,118,291	256,531,349	242,730,986	259,649,158	267,705,597
Vermont	....	....	....	446,223	238,143
Washington	839,254	978,647	1,184,807	1,336,617	1,766,958
Wyoming	87,686	....	331	....	....
Undistributed	390,781	79,577	115,532	104,281	123,509
	1,434,999,962	1,634,249,192	1,674,869,886	1,739,622,094	1,684,040,983

Primary and secondary copper produced by regular refining plants in the United States and imported, 1923–1927, in pounds

	1923	1924	1925	1926	1927
Primary:					
Domestic [1]—					
Electrolytic	1,302,454,492	1,499,223,447	1,533,995,439	1,553,041,424	1,520,076,181
Lake	137,691,306	145,333,227	138,029,764	172,372,304	195,135,199
Casting	24,019,197	29,657,925	10,870,144	5,883,433	3,740,819
	1,464,164,995	1,674,214,599	1,682,895,347	1,731,297,161	1,718,952,199
Foreign [1]—					
Electrolytic	509,873,512	577,100,034	516,632,530	588,932,788	605,748,329
Casting and best select	5,797,109	8,761,377	5,045,947	2,255,427	1,063,181
Total refinery production of new copper	1,979,835,616	2,260,076,010	2,204,573,824	2,322,485,376	2,325,763,709
Imports of refined copper	[2] 160,711,227	145,909,968	99,773,546	170,565,766	103,279,082
Total new refined copper made available	2,140,546,843	2,405,985,978	2,304,347,370	2,493,051,142	2,429,042,791
Secondary:					
Electrolytic	85,297,052	104,281,430	140,349,541	163,061,465	168,766,566
Casting	46,141,409	50,536,678	58,010,653	62,056,941	41,102,000
	131,438,461	154,818,108	198,360,194	225,118,406	209,868,566
	2,271,985,304	2,560,804,086	2,502,707,564	2,718,169,548	2,638,911,357

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

[2] Figures of imports of refined copper from Chile for 1923, as reported by the Chile Exploration Co., have been included here in place of those of the Bureau of Foreign and Domestic Commerce for Chile, which are undoubtedly very low.

In addition to their output of metallic copper, the regular refining companies produced bluestone having copper content as follows: 1923, 7,987,000 pounds; 1924, 5,766,000 pounds; 1925, 6,754,000 pounds; 1926, 8,498,000 pounds; 1927, 9,180,000 pounds.

Stocks of copper in the United States, January 1, 1919–1928, in pounds

Year	Refined copper	Blister and material in process of refining	Year	Refined copper	Blister and material in process of refining
1919	180,000,000	562.600,000	1924	264,000,000	432,000,000
1920	631,000,000	273,000,000	1925	243,000,000	393,000,000
1921	659,000,000	465,000,000	1926	124,000,000	432,000,000
1922	459,000,000	283,000,000	1927	146,000,000	455,000,000
1923	216,000,000	361,000,000	1928	171,000,000	401,000,000

New refined copper withdrawn from total year's supply on domestic account in the United States, 1923–1927, in pounds

	1923	1924	1925	1926	1927
Total supply of new copper	2,140,546,843	2,405,985,978	2,304,347,370	2,493,051,142	2,429,042,791
Stocks at beginning of year	216,000,000	264,000,000	243,000,000	124,000,000	146,000,000
Total available supply	2,356,546,843	2,669,985,978	2,547,347,370	2,617,051,142	2,575,042,791
Copper exported	792,073,512	1,072,243,414	1,022,335,279	900,914,935	981,083,572
Stocks at end of year	264,000,000	243,000,000	124,000,000	146,000,000	171,000,000
	1,056,073,512	1,315,243,414	1,146,335,279	1,046,914,935	1,152,083,572
Withdrawn on domestic account	1,300,473,331	1,354,742,564	1,401,012,091	1,570,136,207	1,422,959,219

Copper (in unmanufactured form) imported for consumption in the United States. 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	569, 182, 467	$131, 064, 639	1923	671, 929, 223	$95, 398, 681
1919	437, 570, 497	88, 751, 115	1924	765, 685, 592	95, 608, 460
1920	480, 297, 985	88, 782, 609	1925	651, 005, 759	83, 948, 686
1921	350, 582, 746	45, 660, 326	1926	779, 437, 231	99, 679, 746
1922	542, 932, 525	65, 786, 811	1927	718, 322, 990	84, 769, 961

Copper (unmanufactured) imported into the United States, 1926 and 1927, in pounds

[General imports]

Country	Ore (copper content)	Concentrates (copper content)	Matte and regulus (copper content)	Unrefined black copper and copper in bars, pigs, or other forms	Refined in bars, plates, rods, or other forms	Old and clippings for remanufacture	Composition metal, copper chief value
1926							
Africa:							
British South				52, 601, 821		2, 967	
Portuguese—							
East		20, 271		83, 314, 732	910, 206		
Other				449, 642		150	
Australia	248, 646		140, 720				
Canada	47, 609, 027	7, 963, 626	107, 655	44, 961, 092	685	6, 002, 507	135, 503
Chile	33, 074, 184	848, 861	202, 836	31, 365, 100	166, 872, 641	343, 351	
Cuba	5, 433, 042	14, 471, 381				1, 926, 861	10, 980
France	1, 146, 285	37, 300	42, 114	1, 131, 955			
Germany	107, 742	623, 836		216, 325	59, 387	205, 171	70, 273
Mexico	2, 862, 187	18, 821, 148	971, 943	82, 320, 581	210, 874	68, 624	
Peru	1, 066, 055	358, 562	99, 945	93, 907, 544		6, 579	
Spain	13, 480, 257			24, 783, 133			
United Kingdom	270, 617	183, 644	250, 783	27, 743, 879	2, 069, 115	890, 199	111, 244
Venezuela	276	1, 345, 408				1, 667	
Other	1, 417, 040	76, 440	313, 046	1, 002, 493	442, 858	1, 553, 513	153, 274
	106, 715, 358	44, 750, 477	2, 129, 042	443, 798, 297	170, 565, 766	11, 001, 589	481, 274
Total value	$13, 452, 075	$5, 351, 557	$261, 443	$56, 101, 041	$23, 335, 640	$1, 114, 436	$63, 769
1927							
Africa:							
Belgian Congo	1, 010			114, 482, 007			
Union of South Africa				2, 697, 436	165		
Australia	307, 397						
Canada	40, 496, 764	10, 537, 756		51, 480, 389	825, 843	5, 639, 111	
Chile	35, 247, 293	5, 548, 687	14, 970	63, 697, 974	100, 839, 354	272, 738	
Cuba	4, 263, 985	25, 108, 017		241, 920	35, 496	628, 987	
France	123, 081	89, 808		123, 309			300
Germany	342, 342	115, 785	68, 896		557, 701	165, 932	57, 342
Mexico	6, 650, 973	25, 286, 667	1, 210, 431	82, 984, 970		132, 337	
Peru	1, 989, 847	19, 112	84, 896	101, 870, 992		73, 744	
Spain	8, 463, 703						
United Kingdom	78, 848	121, 692	14, 275	19, 509, 068	1, 009, 323	72, 853	
Venezuela	136, 572	1, 364, 366				37, 380	
Other	1, 226, 558	910		1, 505, 948	11, 200	454, 530	
	99, 328, 373	68, 192, 800	1, 393, 468	438, 594, 013	103, 279, 082	7, 477, 612	57, 642
Total value	$10, 757, 297	$8, 106, 626	$131, 092	$51, 954, 453	$13, 105, 086	$698, 494	$14, 573

Copper exported from the United States, 1918–1927

Year	Pounds	Value	Year	Pound	Value
1918	747, 689, 580	$195, 840, 637	1923	829, 314, 002	$129, 219, 975
1919	516, 627, 775	117, 417, 055	1924	1, 116, 915, 484	156, 645, 684
1920	624, 053, 701	127, 468, 606	1925	1, 084, 208, 532	161, 165, 820
1921	628, 804, 750	85, 351, 928	1926 [1]	965, 685, 264	139, 853, 365
1922	743, 039, 888	103, 874, 007	1927 [1]	1, 076, 729, 246	149, 114, 730

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[1] Exclusive of "Other manufactures of copper," valued at $1,350,391 in 1926 and at $1,098,886 in 1927, for which quantity is not recorded.

Copper exported from the United States, 1926 and 1927, in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other manufactures of copper
		Bars, ingots, or other forms	Rods						
1926									
Belgium		82, 058, 980	22, 852	18, 632		44, 852	868	6, 782	(1)
Canada	163, 043	15, 288, 339	11, 517, 562	2, 811, 469	2, 286, 220	1, 578, 837	765, 636	1, 749, 467	
China		8, 167, 056		36, 520	15, 852	26, 628	69, 510	280, 205	
Denmark		867, 701	1, 343, 675			1, 225	67, 382	28, 291	
France	109, 673	175, 150, 816	2, 783, 828	365, 933	57	818, 086	163, 324	134, 872	
Germany	4, 610, 828	153, 360, 480		8, 745, 244	2, 360	504, 581	37, 753	4, 515	
India (British)		4, 415, 087		22, 820	3, 429	222, 871	625, 433	195, 536	
Italy		82, 957, 238	111, 031	33, 030	120	336, 721	40, 966	7, 488	
Japan	2, 295	37, 343, 661	1, 590	5, 043, 581	90	9, 460	656, 635	65, 357	
Netherlands		64, 286, 443	112, 181	572, 846	5, 057	38, 042	338, 030	48, 961	
Norway		951, 333	932, 458		1, 313		335	23, 485	
Spain		9, 656, 520	1, 503		153		146	15, 800	
Sweden	112, 323	24, 711, 844			49	3, 087	4, 462	15, 858	
Switzerland							2, 944	43, 925	
United Kingdom	466, 864	180, 320, 237	19, 733, 655	1, 424, 703	20, 417	464, 157	1, 444, 833	792, 457	
Other	126	16, 588, 793	8, 230, 072	351, 334	918, 101	983, 643	8, 822, 871	15, 139, 530	
Total value	5, 465, 152 $611, 630	856, 124, 528 $121, 231, 224	44, 790, 407 $6, 856, 722	19, 426, 112 $2, 178, 330	3, 253, 218 $839, 953	5, 032, 190 $1, 075, 143	13, 041, 128 $2, 244, 235	18, 552, 529 $4, 816, 128	(1) $1, 350, 391
1927									
Belgium	5, 758, 076	89, 498, 171	639, 590	246, 572	35	244, 134	125	17, 205	(1)
Canada	30, 003	15, 445, 902	16, 639, 221	5, 354, 847	2, 014, 079	1, 801, 415	536, 436	1, 692, 577	
China		5, 639, 979		6, 500	1, 121	26, 032	6, 437	94, 700	
Denmark		1, 000, 366	4, 486, 234			2, 192	570	39, 044	
France		111, 957, 106	764, 249	1, 155, 315		347, 380	25, 206	140, 880	
Germany		221, 841, 647		25, 137, 084	58, 381	1, 580, 624	1, 156, 448	486, 778	
India (British)		5, 994, 354	109, 936	366, 530		28, 862	374, 332	489, 209	
Italy		86, 270, 218		325, 490		561, 770	769	3, 932	
Japan	165	24, 475, 434		5, 555, 025	335	4, 680	219, 143	136, 589	
Netherlands	758, 792	104, 600, 674	2, 115, 711	4, 188, 862	661	919, 921	71, 166	55, 194	
Norway	142, 676	1, 436, 616	1, 854, 744			1, 784	36, 396	10, 573	
Spain	7, 548	3, 769, 759	7, 295	666, 679	94		50, 256	56, 882	
Sweden		21, 875, 271		157, 060			1, 048	10, 936	
Switzerland		280, 386					2, 071	7, 059	
United Kingdom	536, 775	182, 565, 499	23, 032, 771	2, 158, 968	20, 223	606, 133	233, 785	1, 205, 595	
Other	2, 090	45, 814, 761	8, 967, 678	99, 346	1, 043, 636	948, 920	7, 574, 367	18, 043, 151	
Total value	7, 236, 125 $784, 617	922, 466, 143 $125, 378, 316	58, 617, 429 $8, 870, 322	45, 418, 278 $5, 127, 889	3, 138, 565 $776, 739	7, 073, 847 $1, 321, 445	10, 288, 555 $1, 689, 316	22, 490, 304 $5, 166, 086	(1) $1, 098, 886

[1] Figures for quantity not recorded.

CORUNDUM

[See Abrasive materials]

CRYOLITE

No natural cryolite is produced in the United States, the entire supply in this country being imported from Greenland. Artificial cryolite is produced by electrochemical processes.

Cryolite imported for consumption in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	1,950	$97,500	1923	6,375	$319,959
1919	2,131	106,956	1924	6,320	320,670
1920	3,864	193,638	1925	9,844	690,651
1921	3,460	295,186	1926	7,599	557,598
1922	3,899	196,302	1927	5,064	410,876

DIATOMITE (INFUSORIAL EARTH)

[See Abrasive materials]

EMERY

[See Abrasive materials]

FELDSPAR

Crude feldspar sold or used by producers in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	88,498	$429,989	1923	145,004	$1,057,595
1919	63,441	347,992	1924	204,772	1,509,339
1920	135,551	851,123	1925	185,706	1,315,654
1921	91,865	617,652	1926	209,989	1,607,101
1922	117,127	844,568	1927	202,497	1,424,755

The foreign trade of the United States in feldspar is small and limited largely to importing from Canada. Imports have been as follows: 1927, 27,424 long tons of crude feldspar, valued at $206,856; 1926, 29,941 tons, $251,896; 1925, 24,994 tons, $203,524; 1924, 35,139 tons, $284,716; 1923, 24,271 tons, $184,924. Prior to September 22, 1922, imports of feldspar were not specifically classified in the official records and are therefore unknown. From that date to the end of the year the imports amounted to 7,549 long tons of crude, valued at $60,111, and 37 long tons of crushed or ground, valued at $538. No imports of crushed or ground feldspar were recorded from 1923 to 1925 but 36 long tons, valued at $1,743, was imported in 1926 and 250 pounds, valued at $3, in 1927.

There is no record of exports of feldspar, and if any feldspar is exported the quantity is doubtless negligible.

FERRO-ALLOYS

Ferro-alloys shipped from furnaces in the United States, 1918–1927, in long tons

Year	Ferro-manganese	Spiegel-eisen	Other varieties	Total	
				Quantity	Value
1918 [1]	306,076	263,861	180,931	750,868	$115,433,943
1919	198,255	90,855	130,528	419,638	53,730,964
1920	276,594	103,672	232,542	612,808	77,519,367
1921	111,374	69,230	68,023	248,627	21,697,785
1922	161,612	70,253	191,415	423,280	28,259,004
1923	226,365	134,086	219,366	579,817	49,877,231
1924	232,821	76,179	188,244	497,244	43,249,948
1925	254,005	95,890	266,327	616,222	53,048,100
1926	330,070	82,982	276,206	689,258	61,368,407
1927	291,056	80,892	274,801	646,749	55,163,574

[1] The figures for 1918 fall short of the actual production of the United States, as the output of certain electrically produced ferro-alloys is not available for publication.

Ferro-alloys shipped from furnaces in the United States, 1926 and 1927

Variety of alloy	1926		1927	
	Long tons	Value	Long tons	Value
Ferromanganese	330,070	$31,711,871	291,056	$27,243,489
Silico-manganese Silico-spiegeleisen	2,183	354,364	3,173	301,321
Spiegeleisen	82,982	2,016,088	80,892	1,986,188
Ferrosilicon (7 per cent or more silicon)	233,428	12,119,465	232,576	11,903,782
Ferromolybdenum and calcium-molybdenum compounds	1,096	1,051,881	(1)	(1)
Ferrotungsten	1,771	2,900,053	1,289	2,185,788
Ferrovanadium	1,777	4,721,903	1,467	3,939,067
Other varieties [2]	35,951	6,492,782	36,296	7,603,939
	689,258	61,368,407	646,749	55,163,574

[1] Included under "Other varieties."

[2] 1926: Ferrochromium, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon; 1927: Ferrochromium, ferromolybdenum and calcium-molybdenum compounds, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon.

Value of ferro-alloys imported for consumption in the United States, 1918–1927

1918	$4,932,042	1923	$9,879,433
1919	5,384,693	1924	5,509,020
1920	10,397,896	1925	7,133,618
1921	1,576,131	1926	6,303,757
1922	7,789,632	1927	4,752,224

Ferro-alloys imported for consumption in the United States, 1926 and 1927

Variety of alloy	1926 Long tons	1926 Value	1927 Long tons	1927 Value
Ferromanganese (manganese content)	47,768	$4,410,142	36,400	$3,553,465
Spiegeleisen	8,783	256,714	7,529	220,979
Ferrochrome and chromium:				
Ferrochrome—				
Containing 3 per cent or more carbon (chromium content)	15	2,569	1	143
Containing less than 3 per cent carbon	495	120,235	143	32,096
Chrome or chromium metal	1	765	10	2,879
Chromium vanadium	20	2,811		
Ferrosilicon (silicon content)	13,038	1,375,227	7,347	923,158
Molybdenum and ferromolybdenum (molybdenum content)	(1)	987	1	5,712
Titanium and ferrotitanium	23	9,189	8	3,310
Tungsten and ferrotungsten (tungsten content)	156	125,118	12	10,482
		6,303,757		4,752,224

[1] 604 pounds.

Ferro-alloys exported from the United States, 1918–1927

Variety of alloy	1918 Long tons	1918 Value	1919 Long tons	1919 Value	1920 Long tons	1920 Value	1921 Long tons	1921 Value	1922 Long tons	1922 Value
Ferromanganese	3,577	$806,087	2,999	$445,840	3,454	$642,570	690	$100,474	1,107	$76,822
Spiegeleisen	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	289	7,740
Ferrochrome and chrome metal	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	23	1,941
Ferrosilicon	4,107	443,456	1,544	145,310	632	41,057	368	20,204	689	30,939
Tungsten and ferrotungsten	550	2,545,087	17	113,276	2	5,913			(2)	43,219
Ferrovanadium	675	1,774,062	29	95,560	173	705,385	98	424,886	22	69,279

Variety of alloy	1923 Long tons	1923 Value	1924 Long tons	1924 Value	1925 Long tons	1925 Value	1926 Long tons	1926 Value	1927 Long tons	1927 Value
Ferromanganese Spiegeleisen	4,295	$151,224	3,165	$92,421	5,496	$160,568	693	$44,111	1,641	$61,71[illegible]
Ferrochrome and chrome metal	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ferrosilicon	814	31,154	775	29,214	(3)	(3)	(3)	(3)	(3)	(3)
Tungsten and ferrotungsten (including tungsten wire)	2	122,906	2	114,775	6	143,987	13	155,653	9	164,917
Ferrovanadium	23	64,713	25	81,016	46	106,754	(3)	(3)	(3)	(3)

[1] Not separately classified prior to 1922. [2] 1,009 pounds. [3] Not separately recorded.

FLUORSPAR

Fluorspar shipped from mines in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	263,817	$5,465,481	1923	121,188	$2,505,819
1919	138,290	3,525,574	1924	124,979	2,451,131
1920	186,778	4,718,547	1925	113,669	2,052,512
1921	34,960	724,094	1926	128,657	2,341,277
1922	141,596	2,531,165	1927	112,546	2,034,728

Fluorspar shipped from mines in the United States, 1925–1927, by States

State	1925		1926		1927	
	Short tons	Value	Short tons	Value	Short tons	Value
Illinois	54,428	$1,024,516	53,734	$1,012,879	46,006	$863,909
Kentucky	44,826	833,794	62,494	1,167,129	57,495	1,040,338
Colorado	11,776	153,707	10,440	161,269	6,432	130,481
New Mexico	2,639	40,325	1,989		2,613	
	113,669	2,052,342	128,657	2,341,277	112,546	2,034,728

Fluorspar imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	12,572	$169,364	1923	41,884	$429,696
1919	6,943	107,631	1924	50,821	551,842
1920	24,612	265,630	1925	48,770	469,540
1921	6,229	69,306	1926	75,626	746,479
1922	33,108	299,188	1927	71,242	594,082

No exports of fluorspar have been reported by Bureau of Foreign and Domestic Commerce. Producers reported 2,764 tons, valued at $65,475, exported in 1920; 2,296 tons, $40,966, in 1922; 1,144 tons, $25,312, in 1923; 617 tons, $14,489, in 1924; 1,055 tons, $17,574, in 1925; 2,132 tons, $34,915, in 1926; and 385 tons, $7,507, in 1927.

FULLER'S EARTH

Fuller's earth sold or used by producers in the United States, 1918–1927

Year	Number of operators	Short tons	Value	Year	Number of operators	Short tons	Value
1918	14	84,468	$1,146,354	1923	15	149,134	$2,247,523
1919	10	106,145	1,998,829	1924	13	177,994	2,632,342
1920	12	128,487	2,506,189	1925	14	206,574	2,923,965
1921	12	105,609	1,973,848	1926	14	234,152	3,356,482
1922	15	138,944	2,289,719	1927	16	264,478	3,767,038

Fuller's earth imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	16,922	$226,235	1923	8,547	$113,944
1919	13,873	189,711	1924	7,302	92,488
1920	19,015	221,893	1925	8,015	111,295
1921	9,744	119,415	1926	9,098	123,674
1922	10,569	135,695	1927	7,580	109,281

Exports of fuller's earth are not reported separately.

GARNET (ABRASIVE)

[See Abrasive materials]

GAS (NATURAL)

Natural gas produced in the United States and delivered to consumers, 1918–1927

[Value at point of consumption]

Year	M cubic feet	Value	Year	M cubic feet	Value
1918	721, 001, 000	$153, 554, 000	1923	1, 006, 976, 000	$240, 001, 000
1919	745, 916, 000	160, 888, 000	1924	1, 141, 521, 000	253, 856, 000
1920	798, 210, 000	196, 194, 000	1925	1, 188, 571, 000	265, 271, 000
1921	662, 052, 000	174, 617, 000	1926	1, 313, 019, 000	300, 168, 000
1922	762, 546, 000	221, 535, 000	1927	1, 445, 428, 000	317, 930, 000

Natural gas produced in the United States and delivered to consumers, 1926 and 1927, by States

[Value at point of consumption]

State	1926		1927	
	M cubic feet	Value	M cubic feet	Value
Arkansas	43, 566, 000	$5, 817, 000	30, 450, 000	$4, 281, 000
California	204, 915, 000	36, 425, 000	212, 364, 000	50, 946, 000
Colorado	553, 800	130, 000	1, 725, 400	290, 000
Illinois	3, 808, 000	863, 000	3, 741, 000	764, 000
Indiana	901, 000	379, 000	1, 124, 000	509, 000
Kansas	38, 095, 000	12, 547, 700	42, 646, 000	12, 833, 000
Kentucky	10, 410, 000	3, 378, 000	10, 206, 000	3, 277, 000
Louisiana	157, 423, 000	8, 768, 000	186, 961, 000	12, 158, 000
Michigan	400	200	600	300
Missouri	1, 000	700	300	200
Montana	2, 283, 000	450, 000	4, 253, 100	716, 400
New Mexico	921, 000	75, 000	1, 019, 000	48, 500
New York	7, 027, 000	4, 499, 000	5, 908, 000	3, 841, 000
North Dakota	(1)	(1)	200	100
Ohio	47, 363, 000	25, 403, 000	51, 381, 000	28, 881, 000
Oklahoma	286, 421, 000	42, 140, 000	326, 864, 000	41, 391, 000
Pennsylvania	107, 089, 000	50, 040, 000	105, 709, 500	49, 135, 000
South Dakota	10, 100	14, 000	92, 000	136, 500
Tennessee	11, 500	1, 900	9, 000	2, 200
Texas	175, 392, 000	28, 165, 000	254, 063, 000	37, 424, 800
West Virginia	180, 223, 000	76, 396, 000	162, 375, 000	67, 994, 000
Wyoming	46, 567, 000	4, 669, 000	43, 581, 600	3, 269, 800
Other [2]	38, 200	6, 500	954, 300	31, 200
	1, 313, 019, 000	300, 168, 000	1, 445, 428, 000	317, 930, 000

[1] Included under "Other."

[2] 1926: Alaska and North Dakota; 1927: Alaska, Mississippi, Utah.

GASOLINE FROM NATURAL GAS

Natural gasoline produced in the United States, 1918–1927

Year	Raw (unblended) gasoline produced		Natural gas treated (estimated) (M cubic feet)
	Gallons	Value at plant	
1918	282, 535, 550	$50, 363, 535	449, 109, 000
1919	351, 535, 026	64, 196, 763	480, 404, 000
1920	384, 743, 922	71, 788, 122	496, 431, 000
1921	449, 934, 402	61, 815, 258	465, 097, 000
1922	505, 832, 000	72, 711, 063	545, 139, 000
1923	816, 226, 000	77, 268, 000	875, 711, 000
1924	933, 861, 000	82, 232, 000	1, 016, 276, 000
1925	1, 127, 470, 000	120, 383, 000	1, 040, 390, 000
1926	1, 363, 090, 000	136, 412, 000	1, 206, 300, 000
1927	1, 641, 144, 000	118, 688, 000	1, 341, 248, 000

Natural gasoline produced in the United States, 1926 and 1927, by States

State	1926		1927	
	Gallons	Value	Gallons	Value
Alaska	33, 000	$4, 000	19, 000	$2, 000
Arkansas	30, 385, 000	2, 867, 000	37, 498, 000	2, 281, 000
California	389, 366, 000	[1] 45, 945, 000	498, 020, 000	52, 436, 000
Colorado	276, 000	17, 000	912, 000	64, 000
Illinois	9, 987, 000	967, 000	8, 853, 000	532, 000
Kansas	25, 369, 000	2, 105, 000	36, 095, 000	1, 746, 000
Kentucky	7, 689, 000	914, 000	7, 480, 000	547, 000
Louisiana	43, 557, 000	3, 692, 000	44, 844, 000	2, 442, 000
New Mexico	1, 488, 000	146, 000	1, 827, 000	109, 000
New York	539, 000	66, 000	449, 000	38, 000
Ohio	10, 817, 000	1, 402, 000	12, 167, 000	1, 062, 000
Oklahoma	475, 716, 000	41, 433, 000	548, 109, 000	29, 114, 000
Pennsylvania	20, 343, 000	2, 454, 000	16, 744, 000	1, 648, 000
Texas	243, 093, 000	22, 760, 000	320, 723, 000	18, 347, 000
West Virginia	63, 807, 000	7, 706, 000	64, 192, 000	5, 421, 000
Wyoming	40, 625, 000	3, 934, 000	43, 212, 000	2, 899, 000
	1, 363, 090, 000	136, 412, 000	1, 641, 144, 000	118, 688, 000

[1] Estimate.

GEMS AND PRECIOUS STONES

Value of precious stones produced in the United States, 1918–1923 [1]

Year	Value	Year	Value
1918	$106, 523	1921	[2] $518, 280
1919	111, 763	1922	[2] 71, 106
1920	265, 205	1923 (estimate)	65, 000

[1] Canvass discontinued after 1923.
[2] Production of diamond in Arkansas not reported.

Value of diamonds and other precious stones imported for consumption in the United States, 1918–1927

Year	Diamonds				Other stones not set	Total, excluding pearls	Pearls
	Glazier's	Dust and bort	Rough or uncut	Cut but not set			
1918	$718, 397	$475, 870	$12, 636, 024	$7, 734, 150	$1, 102, 398	$22, 666, 839	$765, 929
1919	984, 381	1, 420, 442	20, 306, 758	64, 085, 610	5, 161, 639	91, 958, 830	11, 008, 973
1920	1, 527, 753	3, 387, 488	10, 526, 125	45, 240, 013	5, 419, 363	66, 100, 742	7, 879, 384
1921	435, 872	466, 345	2, 207, 365	26, 144, 323	2, 778, 931	32, 032, 836	4, 492, 063
1922	839, 882	1, 029, 261	8, 332, 416	43, 144, 742	3, 723, 062	57, 069, 363	8, 546, 574
1923	1, 065, 834	228, 409	7, 241, 550	51, 975, 896	5, 703, 279	66, 214, 968	7, 932, 929
1924	1, 116, 862	259, 482	11, 666, 587	47, 108, 169	5, 214, 130	65, 365, 230	5, 898, 560
1925	1, 976, 640	760, 476	9, 492, 328	49, 723, 818	5, 228, 011	67, 181, 273	6, 734, 149
1926	1, 939, 735	271, 382	13, 070, 767	51, 353, 168	6, 333, 779	72, 968, 831	5, 322, 140
1927	2, 148, 275	62, 045	11, 452, 439	40, 714, 672	4, 529, 350	58, 906, 781	6, 043, 162

Domestic exports in 1922 were as follows: "Diamonds, cut but not set," 15 carats, valued at $1,540; "other precious stones, including pearls," $21,525. Data are not separately classified prior to 1922. For 1923 to 1927, domestic exports are recorded as "Precious stones, including pearls," as follows: 1923, $78,967; 1924, $146,825; 1925, $39,823; 1926, $64,377; 1927, $87,291.

Value of foreign precious stones reexported from the United States, 1918–1927

Year	Diamonds			Other precious stones		Total, excluding pearls	Pearls and parts of, not strung or set
	Uncut	Cut but not set	Bort	Uncut	Cut but not set		
1918			$56	$100	$57	$213	$42,908
1919	$3,238	$25,000	(1)	[1] 15,653	1,783	45,674	5,386
1920			(1)	[1] 4,604	13,338	17,942	8,000
1921		896	(1)	[1] 14,390	9,353	24,639	128
1922	19,735	1,396	(1)	[1] 7,387	7,546	36,064	728
1923–1927	(2)	(2)	(2)	(2)	(2)	(2)	(2)

[1] Bort included under "Other precious stones—uncut."

[2] Foreign exports for 1923 to 1925 are recorded as "Diamonds and precious stones," as follows: 1923, 535,840 carats, valued at $27,123; 1924, 47,797 carats, $69,230; 1925, 32,959 carats, $26,983. Beginning 1926 they are recorded as "Precious stones and imitations," and valued as follows: 1926, $57,304; 1927, $62,494.

GOLD AND SILVER [1]

Gold and silver produced in the United States, 1918–1927

Year	Gold		Silver	
	Troy ounces	Value	Troy ounces	Commercial value
1918	3,320,784	$68,646,700	67,810,139	$66,485,129
1919	2,918,628	60,333,400	56,682,445	63,533,652
1920	2,476,166	51,186,900	55,361,573	60,801,955
1921	2,422,006	50,067,300	53,052,441	53,052,441
1922	2,363,075	48,849,100	56,240,048	56,240,048
1923	2,502,632	51,734,000	73,335,170	60,134,839
1924	2,528,900	52,277,000	65,407,186	43,822,814
1925	2,411,987	49,860,200	66,155,424	45,911,864
1926	2,335,042	48,269,600	62,718,746	39,136,497
1927	2,197,125	45,418,600	60,434,441	34,266,328

[1] Gold is valued by law at $20.67+ a troy ounce. For prices of silver, see statement on p. A11.

Gold produced in the United States, 1926 and 1927, by States [1]

State	1926		1927	
	Troy ounces	Value [2]	Troy ounces	Value [2]
Alaska	325,186	$6,722,200	286,298	$5,918,300
Arizona	232,200	4,800,000	203,088	4,198,200
California	581,700	12,024,800	564,981	11,679,200
Colorado	346,297	7,158,600	259,111	5,356,300
Georgia	140	2,900	15	300
Idaho	12,640	261,300	15,209	314,400
Montana	57,707	1,192,900	56,076	1,159,200
Nevada	170,880	3,532,400	149,445	3,089,300
New Mexico	20,105	415,600	26,098	539,500
North Carolina	121	2,500	34	700
Oregon	13,303	275,000	14,425	298,200
Pennsylvania	106	2,200	126	2,600
Philippine Islands	96,426	1,993,300	79,872	1,651,100
South Carolina	15	300		
South Dakota	286,961	5,932,000	322,681	6,670,400
Tennessee	416	8,600	426	8,800
Texas	164	3,400	324	6,700
Utah	181,832	3,758,800	199,518	4,124,400
Virginia	10	200		
Washington	8,833	182,600	19,398	401,000
	2,335,042	48,269,600	2,197,125	45,418,600

[1] Figures furnished by the Bureau of the Mint.

[2] Gold value, $20.67+ a troy ounce.

Silver produced in the United States, 1926 and 1927, by States [1]

State	1926		1927	
	Troy ounces	Value [2]	Troy ounces	Value [2]
Alaska	707,454	$441,451	606,129	$343,675
Arizona	7,516,708	4,690,426	6,601,467	3,743,032
California	1,977,956	1,234,244	1,557,812	883,279
Colorado	5,037,574	3,143,446	3,941,351	2,234,746
Georgia	11	7	4	2
Idaho	7,563,644	4,719,714	8,928,619	5,062,527
Illinois	3,081	1,922	1,500	850
Michigan	107,094	66,827	51,742	29,338
Missouri	71,839	44,827	87,218	49,453
Montana	11,974,257	7,471,936	11,809,765	6,696,137
Nevada	6,450,224	4,024,940	5,372,900	3,046,434
New Mexico	496,634	309,900	754,878	428,016
North Carolina	22	14	134	76
Oregon	28,861	18,009	41,673	23,629
Pennsylvania	1,479	923	2,299	1,303
Philippine Islands	45,793	28,575	40,242	22,817
South Dakota	82,789	51,660	95,123	53,935
Tennessee	95,783	59,769	82,275	46,650
Texas	463,611	289,293	942,971	534,664
Utah	19,936,032	12,440,084	19,353,758	10,973,581
Vermont	1,948	1,216	938	532
Washington	155,952	97,314	161,643	91,652
	62,718,746	39,136,497	60,434,441	34,266,328

[1] Figures furnished by the Bureau of the Mint.

[2] Valued at average New York price of bar silver, as follows: 1926, 62.4 cents an ounce; 1927, 56.7 cents an ounce.

Value of gold and silver imported into and exported from the United States, 1918–1927

Year	Gold		Silver	
	Imports	Exports	Imports	Exports
1918	$62,042,748	$41,069,818	$71,375,699	$252,846,464
1919	76,534,046	368,185,248	89,410,018	239,021,051
1920	417,068,273	322,091,208	88,060,041	113,616,224
1921	691,248,297	23,891,377	63,242,671	51,575,399
1922	275,169,785	36,874,894	70,806,653	62,807,286
1923	322,715,812	28,643,417	74,453,530	72,468,789
1924	319,720,918	61,648,313	73,944,902	109,891,033
1925	128,273,172	262,639,790	64,595,418	99,127,585
1926	213,504,020	115,707,815	69,595,936	92,257,564
1927	207,535,195	201,455,100	55,073,917	75,624,780

Value of gold and silver imported into and exported from the United States, 1926 and 1927, by classes

	Imports	Exports	Excess of—	
			Imports	Exports
1926				
Gold:				
Contained in domestic ore and base bullion		$207,725		$207,725
Contained in foreign ore and base bullion	$20,872,276		$20,872,276	
Domestic bullion refined	874,633	9,536,867		8,662,234
Foreign bullion refined	71,130,166	1,281	71,128,885	
United States coin	53,971,385	104,349,771		50,378,386
Foreign coin	66,655,560	1,612,171	65,043,389	
	213,504,020	115,707,815	157,044,550	59,248,345
Excess imports over exports			97,796,205	
Silver:				
Contained in domestic ore and base bullion		53,573		53,573
Contained in foreign ore and base bullion	46,170,162	381	46,169,781	
Domestic bullion refined		73,961,544		73,961,544
Foreign bullion refined	21,098,685	14,581,915	6,516,770	
United States coin	1,559,943	542,470	1,017,473	
Foreign coin	767,146	3,117,681		2,350,535
	69,595,936	92,257,564	53,704,024	76,365,652
Excess exports over imports				22,661,628
1927				
Gold:				
Contained in domestic ore and base bullion		330,246		330,246
Contained in foreign ore and base bullion	18,110,866	2,350	18,108,516	
Domestic bullion refined		54,608,475		54,608,475
Foreign bullion refined	87,262,450	21	87,262,429	
United States coin	71,001,720	146,302,604		75,300,884
Foreign coin	31,160,159	211,404	30,948,755	
	207,535,195	201,455,100	136,319,700	130,239,605
Excess imports over exports			6,080,095	
Silver:				
Contained in domestic ore and base bullion		70,157		70,157
Contained in foreign ore and base bullion	32,056,952		32,056,952	
Domestic bullion refined	31,795	59,848,110		59,816,315
Foreign bullion refined	20,745,549	13,200,447	7,545,102	
United States coin	902,909	396,482	506,427	
Foreign coin	1,336,712	2,109,584		772,872
	55,073,917	75,624,780	40,108,481	60,659,344
Excess exports over imports				20,550,863

GRAPHITE

Natural graphite sold or used by producers in the United States, 1918–1927

Year	Amorphous		Crystalline	
	Short tons	Value	Pounds	Value
1918	6,560	$69,455	12,861,839	$1,454,799
1919	3,379	47,716	8,086,191	731,141
1920	4,694	49,758	9,622,360	576,444
1921	1,842	20,860	1,189,523	75,664
1922	2,200	(1)	1,849,766	85,242
1923	4,056	39,560	3,964,900	151,434
1924	4,071	38,533	1,800,325	48,977
1925	3,536	39,640	2,257,250	56,721
1926	2,975	40,500	4,989,200	178,842
1927	2,595	35,850	5,224,400	197,121

[1] Bureau of Mines not at liberty to publish value.

Graphite is manufactured by the Acheson Graphite Co. at Niagara Falls, N. Y. The figures that follow are published by permission of this company.

Graphite manufactured by the Acheson Graphite Co., 1918–1927, in pounds

1918	9, 182, 272	1923	26, 761, 015
1919	8, 163, 177	1924	10, 986, 192
1920	7, 399, 749	1925	12, 135, 655
1921	5, 888, 000	1926	21, 163, 986
1922	13, 031, 926	1927	12, 257, 239

Graphite imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports		
			Unmanufactured		Manufactures of
	Short tons	Value	Short tons	Value	
1918	19, 498	$3, 092, 475	954	$121, 555	$731, 518
1919	26, 626	2, 978, 096	629	90, 185	788, 755
1920	21, 095	1, 711, 312	607	112, 771	610, 261
1921	8, 183	452, 076	921	95, 998	679, 359
1922	12, 488	473, 046	569	78, 094	[1] 255, 019
1923	[2] 19, 434	[2] 614, 119	908	138, 542	[1] 335, 778
1924	[2] 16, 375	[2] 399, 511	1, 022	144, 108	[1] 250, 957
1925 [3]	[2] 17, 768	[2] 826, 410	945	142, 122	[1] 337, 481
1926 [3]	[2] 16, 166	[2] 921, 233	405	49, 235	[1] 463, 084
1927 [3]	[2] 17, 452	[2] 723, 923	[4] 1, 819	[4] 435, 997	([4])

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[1] Exclusive of crucibles, figures for which are not available.

[2] Composed of the following: 1923, "amorphous," 11,252 tons, $149,831; "crystalline lump, chip, or dust," 7,243 tons, $426,417; and "crystalline flake," 939 tons, $37,871; 1924, 10,936 tons, $113,751; 3,998 tons, $197,867, and 1,441 tons, $87,893; 1925, 9,210 tons, $143,750; 5,904 tons, $389,242; and 2,654 tons, $293,418; 1926, 8,250 tons, $161,564; 5,258 tons, $433,848; and 2,658 tons, $325,821; and 1927, 9,559 tons, $146,881; 6,116 tons, $390,822; and 1,777 tons, $186,220, respectively. Classes not separately shown for earlier years.

[3] Imports of graphite crucibles were not separately classified until 1925 when 3,100 crucibles, valued at $548, were imported; corresponding imports for 1926 were 9,513 crucibles, $11,780, and for 1927, 2,583 crucibles, $1,812; weight not recorded.

[4] Classification for 1927 reads "Graphite and manufactures, except crucibles."

GRINDSTONES AND PULPSTONES

[See Abrasive materials]

GYPSUM

Gypsum produced in the United States and sold by producers, 1918–1927

Year	Crude produced (short tons)	Crude and calcined sold (total value)	Year	Crude produced (short tons)	Crude and calcined sold (total value)
1918	2, 057, 015	$11, 470, 854	1923	4, 753, 448	$34, 888, 155
1919	2, 420, 163	15, 727, 907	1924	5, 042, 629	42, 724, 507
1920	3, 129, 142	24, 533, 065	1925	5, 678, 302	47, 577, 240
1921	2, 890, 784	23, 700, 290	1926	5, 635, 441	46, 721, 219
1922	3, 779, 949	29, 361, 151	1927	5, 346, 888	42, 174, 454

Gypsum imported for consumption in the United States, 1918-1927

Year	Crude		Ground or calcined		Value of manufactured plaster of Paris	Keenes cement		Total value
	Short tons	Value	Short tons	Value		Short tons	Value	
1918	50,653	$55,004	6,117	$70,028	$1,765	111	$2,259	$129,056
1919	171,733	211,946	10,415	126,405	7,719	187	5,984	352,054
1920	282,486	397,942	14,921	179,191	10,282	202	5,338	592,753
1921	266,796	364,318	4,495	55,109	33,072	184	6,836	459,335
1922	409,475	523,939	1,774	32,651	55,116	403	9,636	621,342
1923	448,129	629,203	5,133	77,716	41,317	418	11,543	759,779
1924	519,627	724,864	5,217	70,793	48,059	539	12,042	855,758
1925	634,423	915,888	10,759	140,941	56,724	449	11,294	1,124,847
1926	824,081	1,276,131	7,149	99,058	96,355	578	15,701	1,487,245
1927	828,619	1,167,581	8,650	114,947	89,096	655	16,202	1,387,826

Exports of gypsum are designated as "Gypsum or plaster, crude, ground, calcined, and manufactures of," and have been as follows: 1927, 18,429 short tons, valued at $471,106; 1926, 19,610 tons, $576,585; 1925, 16,798 tons, $498,616; 1924, 10,623 tons, $358,425; 1923, 8,815 tons, $226,423; 1922, 7,673 tons, $178,166. Exports are not separately classified for earlier years.

ILMENITE

[See Titanium minerals]

IRON ORE, PIG IRON, AND STEEL

IRON ORE

[Exclusive of all domestic ore containing 5 per cent or more of manganese. For data regarding such ore, see Manganese]

Iron ore mined in the United States, 1918–1927, by varieties, in long tons

Year	Hematite	Brown ore	Magnetite	Carbonate	Total
1918	65,894,709	1,613,844	2,149,725	------------	69,658,278
1919	[1] 57,719,582	1,127,397	[1] 2,118,439	------------	60,965,418
1920	[1 2] 63,883,523	[2] 1,325,661	[1] 2,391,541	3,740	67,604,465
1921	[1 2] 28,337,249	[2] 370,154	[1] 780,866	2,709	29,490,978
1922	[2] 44,888,723	[2] 783,582	1,452,966	3,256	47,128,527
1923	[2] 65,924,454	[2] 1,232,848	2,190,624	3,516	69,351,442
1924	[2] 52,102,300	[2] 814,159	1,347,711	3,249	54,267,419
1925	[2] 59,546,690	[2] 884,600	1,472,004	4,703	61,907,997
1926	[2 3] 64,634,573	[2] 810,924	[3] 2,175,288	2,215	67,623,000
1927	[2 3] 58,505,543	[2] 743,478	[3] 2,489,586	2,493	61,741,100

[1] Some magnetite included with hematite.
[2] Some hematite included with brown ore.
[3] Some hematite included with magnetite.

Iron ore mined in the United States, 1926 and 1927, by mining districts and varieties, in long tons

District	Hematite	Brown ore	Magnetite	Carbonate	Total
1926					
Lake Superior [1]	57, 143, 407				57, 143, 407
Birmingham	6, 114, 917	393, 300			6, 508, 217
Chattanooga	198, 574	68, 550			267, 124
Adirondack Northern New Jersey and southeastern New York			[2] 847, 966		[2] 847, 966
Other districts	[2,3] 1, 177, 675	[3] 349, 074	1, 327, 322	2, 215	[2] 2, 856, 286
	[2,3] 64, 634, 573	[3] 810, 924	[2] 2, 175, 288	2, 215	67, 623, 000
1927					
Lake Superior [1]	51, 539, 880				51, 539, 880
Birmingham	5, 857, 326	437, 487			6, 294, 813
Chattanooga	89, 351	70, 897			160, 248
Adirondack Northern New Jersey and southeastern New York			[2] 1, 073, 819		[2] 1, 073, 819
Other districts	[2,3] 1, 018, 986	[3] 235, 094	1, 415, 767	2, 493	[2] 2, 672, 340
	[2,3] 58, 505, 543	[3] 743, 478	[2] 2, 489, 586	2, 493	61, 741, 100

[1] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[2] Some hematite from "Other districts" included with magnetite from Adirondack district.
[3] Some hematite included with brown ore.

Iron ore mined in the Lake Superior district, 1918–1927, by ranges, in long tons

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1918	3, 946, 554	6, 041, 637	7, 837, 634	1, 192, 677	39, 055, 977	1, 705, 315	59, 779, 794
1919	4, 158, 751	4, 863, 968	7, 368, 994	1, 051, 795	33, 262, 954	1, 685, 877	52, 392, 339
1920	4, 457, 609	5, 651, 542	8, 298, 206	1, 053, 518	36, 641, 880	1, 757, 775	57, 860, 530
1921	2, 204, 114	2, 147, 569	3, 135, 477	981, 576	16, 380, 190	449, 559	25, 298, 485
1922	2, 745, 626	3, 290, 641	4, 910, 789	1, 108, 764	26, 704, 601	955, 595	39, 716, 016
1923	3, 910, 909	4, 913, 541	6, 112, 662	1, 119, 113	41, 809, 018	1, 420, 165	59, 285, 408
1924	3, 579, 087	3, 780, 664	5, 579, 883	1, 141, 690	29, 818, 965	941, 430	44, 841, 719
1925	3, 813, 687	5, 009, 022	6, 377, 710	1, 331, 753	34, 851, 109	673, 382	52, 056, 663
1926	4, 046, 191	5, 445, 683	6, 949, 920	1, 568, 953	37, 997, 797	1. 134, 863	57, 143, 407
1927	4, 015, 730	5, 458, 182	6, 604, 830	1, 577, 817	32, 866, 034	1, 017, 287	51, 539, 880

Iron ore shipped from mines in the United States, 1918–1927

[Exclusive of ore sold for paint. See p. A64]

Year	Long tons	Value	Year	Long tons	Value
1918	72, 021, 202	$244, 368, 147	1923	69, 811, 472	$240, 738, 921
1919	56, 372, 784	197, 312, 517	1924	52, 083, 375	151, 307, 105
1920	69, 281, 341	285, 006, 327	1925	63, 924, 763	160, 796, 886
1921	26, 652, 528	89, 745, 308	1926	69, 292, 832	174, 015, 645
1922	50, 612, 620	157, 809, 286	1927	61, 232, 473	151, 125. 820

Iron ore shipped from mines in the United States, 1926 and 1927, by States

[Exclusive of ore sold for paint. See p. A64]

State	1926		1927	
	Long tons	Value	Long tons	Value
Alabama	6, 871, 412	$13, 846, 656	6, 508, 419	$12, 973, 597
California	282	(1)		
Colorado	35, 535	(1)	32, 206	(1)
Georgia	51, 642	149, 198	50, 312	147, 068
Michigan	16, 699, 984	43, 932, 982	14, 532, 831	37, 135, 364
Minnesota	40, 961, 361	103, 715, 621	35, 563, 177	87, 935, 099
Missouri	124, 371	532, 536	78, 605	315, 670
Montana	724	1, 810	2, 837	10, 156
New Jersey	212, 152	925, 403	202, 720	860, 393
New Mexico	216, 269	(1)	214, 747	(1)
New York	659, 741	3, 015, 586	936, 850	4, 568, 224
North Carolina	14, 798	31, 645	32, 528	81, 753
Pennsylvania	1, 088, 634	2, 483, 056	1, 124, 883	2, 559, 916
Tennessee	138, 307	312, 109	121, 220	274, 620
Utah	296, 943	411, 611	222, 879	(1)
Virginia	49, 703	162, 446	66, 897	172, 877
Washington	1, 702	(1)	550	(1)
Wisconsin	1, 238, 885	3, 178, 156	937, 935	2, 567, 078
Wyoming	630, 387	(1)	602, 877	(1)
Undistributed		[2] 1, 316, 830		[2] 1, 524, 005
	69, 292, 832	174, 015, 645	61, 232, 473	151, 125, 820

[1] Included under "Undistributed."
[2] This figure covers States entered as "(1)" above.

Stocks of iron ore at mines in the United States, December 31, 1918–1927, in long tons

1918	8, 565, 893	1923	10, 165, 875
1919	13, 097, 500	1924	12, 410, 619
1920	11, 378, 794	1925	10, 795, 630
1921	13, 836, 267	1926	9, 565, 880
1922	10, 524, 279	1927	10, 104, 673

Stocks of iron ore at mines in the United States, December 31, 1926 and 1927, in long tons

State	1926	1927	State	1926	1927
Alabama	912, 702	848, 850	New York	214, 522	116, 774
Iowa	12, 165	12, 165	Pennsylvania	42, 263	85, 322
Michigan	5, 527, 102	6, 089, 053	Virginia	25, 929	22, 060
Minnesota	2, 505, 982	2, 518, 000	Wisconsin	175, 629	243, 585
Missouri	2, 629	2, 629			
New Jersey	146, 957	166, 235		9, 565, 880	10, 104, 673

Iron ore imported into and exported from the United States, 1918–1927

Year	Imports		Exports	
	Long tons	Value	Long tons	Value
1918	787, 468	$3, 464, 304	1, 256, 383	$5, 535, 090
1919	476, 461	2, 385, 689	996, 569	4, 308, 746
1920	1, 273, 456	4, 963, 654	1, 145, 037	6, 198, 927
1921	315, 768	1, 075, 909	440, 106	2, 077, 620
1922	1, 135, 156	4, 916, 294	602, 194	2, 770, 878
1923	2, 768, 430	11, 308, 503	1, 116, 932	5, 305, 365
1924	2, 047, 055	10, 580, 904	595, 413	2, 407, 003
1925	2, 190, 697	6, 895, 229	630, 521	2, 411, 093
1926	2, 555, 441	5, 876, 316	868, 710	3, 380, 701
1927	2, 620, 717	6, 068, 283	898, 793	3, 425, 435

PIG IRON

Pig iron shipped from blast furnaces in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	38,230,440	$1,180,759,565	1923	38,361,379	$946,799,378
1919	30,130,231	775,915,043	1924	31,064,129	665,078,972
1920	35,710,227	1,140,904,096	1925	36,814,702	739,316,333
1921	16,038,619	389,437,792	1926	38,181,053	749,633,468
1922	27,670,738	608,144,858	1927	34,866,644	646,226,139

Pig iron shipped from blast furnaces in the United States, 1926 and 1927, by States

State	1926		1927	
	Long tons	Value	Long tons	Value
Alabama	2,875,534	$58,119,260	2,705,240	$50,193,057
Colorado	(1)	(1)	(1)	(1)
Illinois	3,626,330	73,460,392	3,466,203	66,442,068
Indiana	3,670,478	69,292,329	3,447,764	62,097,518
Kentucky	148,053	(1)	184,851	(1)
Maryland	791,637	(1)	845,564	(1)
Massachusetts	23,130	(1)	129,039	(1)
Michigan	638,282	13,180,113	626,532	12,527,993
Minnesota	292,658	(1)	287,813	(1)
New Jersey	(1)	(1)	-------	-------
New York	2,389,665	44,970,196	2,401,432	40,803,579
Ohio	9,177,127	176,433,401	8,184,066	150,125,790
Pennsylvania	13,142,528	263,238,184	11,145,334	212,179,275
Tennessee	113,029	2,544,825	87,971	1,911,380
Utah	(1)	(1)	(1)	(1)
Virginia	105,019	2,322,451	84,920	1,782,538
West Virginia	364,302	(1)	504,816	(1)
Wisconsin	235,597	5,034,012	(1)	(1)
Undistributed	[2] 587,684	[2] 41,038,305	[2] 765,099	[2] 48,162,941
	38,181,053	749,633,468	34,866,644	646,226,139

[1] Included under "Undistributed."

[2] This figure covers States entered as "(1)" above.

Pig iron[1] imported into and exported from the United States, 1918–1927

Year	Imports		Exports	
	Long tons	Value	Long tons	Value
1918[1]	34,711	$4,968,056	269,575	$11,576,721
1919[1]	101,665	6,565,106	321,261	12,313,183
1920[1]	185,944	12,801,834	216,828	10,074,377
1921[1]	44,036	2,014,926	28,307	933,093
1922	383,445	8,670,860	30,920	756,842
1923	367,778	9,005,077	32,318	862,443
1924	209,109	3,741,213	41,483	957,921
1925	441,425	7,951,283	32,674	724,565
1926	445,773	7,708,982	25,208	523,883
1927	132,568	2,254,355	50,992	1,028,425

[1] Figures for 1918 to 1921 include ferro-alloys. Separate data not available prior to 1922.

STEEL

Steel produced in the United States, 1918–1927, in long tons [1]

Year	Bessemer	Open-hearth	Crucible	Other steel	Total
1918	9, 376, 236	34, 459, 391	115, 112	511, 693	44, 462, 432
1919	7, 271, 562	26, 948, 694	63, 572	387, 404	34, 671, 232
1920	8, 883, 087	32, 671, 895	72, 265	505, 687	42, 132, 934
1921	4, 015, 938	15, 589, 802	7, 613	170, 444	19, 783, 797
1922	5, 919, 298	29, 308, 983	28, 606	346, 039	35, 602, 926
1923	8, 484, 088	35, 899, 657	44, 079	515, 872	44, 943, 696
1924	5, 899, 590	31, 577, 350	22, 473	432, 526	37, 931, 939
1925	6, 723, 962	38, 034, 488	19, 562	615, 512	45, 393, 524
1926	6, 934, 568	40, 691, 979	15, 493	651, 723	48, 293, 763
1927	6, 191, 727	38, 068, 335	9, 036	666, 087	44, 935, 185

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[1] According to the American Iron and Steel Institute.

LEAD [1]

Refined primary lead produced in the United States from domestic ores, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	539, 905	$76, 667, 000	1923	543, 841	$76, 138, 000
1919	424, 433	44, 990, 000	1924	566, 407	90, 625, 000
1920	476, 849	76, 296, 000	1925	654, 921	113, 956, 000
1921	398, 222	35, 840, 000	1926	680, 685	108, 910, 000
1922	468, 746	51, 562, 000	1927	668, 320	84, 208, 000

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[1] For prices of lead, see statement on p. A11.

Refined primary lead produced in the United States, 1923–1927, in short tons

	1923	1924	1925	1926	1927
Domestic ore:					
Desilverized lead	291, 760	299, 343	345, 429	366, 413	378, 889
Soft lead	190, 749	203, 615	260, 560	258, 565	233, 944
Desilverized soft lead	61, 332	63, 449	48, 932	55, 707	55, 487
Total from domestic ore	543, 841	566, 407	654, 921	680, 685	668, 320
Foreign ore:					
Africa	99	6	----------	6	12
Canada	3, 632	4, 633	10, 676	5, 385	4, 138
Central America	18	30	6	----------	18
Mexico	18, 867	33, 328	31, 107	32, 693	22, 674
South America	1, 461	7, 663	4, 496	9, 893	5, 506
Other foreign	211	725	739	233	21
Foreign base bullion: Mexico	50, 193	77, 701	65, 024	70, 046	95, 841
Total from foreign ore and base bullion	74, 481	124, 086	112, 048	118, 256	128, 210
Grand total from all sources	618, 322	690, 493	766, 969	798, 941	796, 530
Production of antimonial lead	14, 190	20, 787	19, 667	22, 524	24, 347

Secondary lead recovered in the United States, 1918–1927

Year	Pig lead (short tons)	Lead in alloys (short tons)	Total	
			Short tons	Value
1918	41, 146	55, 954	97, 100	$13, 788, 000
1919	55, 684	66, 416	122, 100	12, 943, 000
1920	56, 350	68, 300	124, 650	19, 944, 000
1921	46, 370	57, 410	103, 780	9, 340, 000
1922	75, 480	84, 080	159, 560	17, 552, 000
1923	96, 430	98, 060	194, 490	27, 229, 000
1924	90, 400	114, 100	204, 500	32, 720, 000
1925	112, 420	114, 460	226, 880	39, 477, 100
1926	125, 000	152, 300	277, 300	44, 368, 000
1927	119, 000	157, 000	276, 000	34, 776, 000

Lead imported for consumption in the United States, 1918–1927, by classes

Year	Lead in ore [1]		Lead in base bullion		Pigs, bars, and old [2]		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value		
1918	6, 064, 902	$344, 080	3, 559, 071	$180, 070	1, 139, 950	$56, 694	6, 892	$624	$36, 723	$618, 191
1919	4, 106, 823	196, 363	31, 796, 693	1, 130, 937	10, 174, 115	415, 094	8, 018	628	17, 187	1, 760, 209
1920	13, 700, 499	908, 619	66, 816, 820	3, 340, 600	68, 901, 959	3, 887, 821	81, 396	5, 483	21, 328	8, 163, 851
1921	6, 842, 807	327, 046	56, 819, 980	1, 668, 410	61, 909, 094	1, 972, 716	3, 087	140	11, 204	3, 979, 516
1922	23, 649, 851	812, 603	55, 859, 422	1, 815, 142	8, 563, 110	335, 924	6, 018	697	12, 286	2, 976, 652
1923	22, 420, 046	1, 190, 414	11, 124, 151	626, 201	42, 925, 265	2, 510, 466	19, 525	4, 495	90, 027	4, 421, 603
1924	65, 147, 976	3, 145, 791	28, 796, 402	1, 542, 167	27, 362, 392	1, 850, 862	11, 666	4, 384	138, 637	6, 681, 841
1925	12, 706, 508	672, 112	24, 747, 665	1, 823, 566	15, 464, 205	1, 038, 350	27, 579	10, 429	139, 533	3, 683, 990
1926	58, 752, 911	3, 393, 039	13, 341, 038	972, 758	24, 365, 570	2, 191, 658	864, 342	101, 322	62, 895	6, 721, 672
1927	70, 260, 478	4, 203, 897	14, 629, 606	925, 328	9, 933, 679	635, 807	988, 170	104, 890	52, 626	5, 922, 548

[1] Includes also lead in matte beginning Sept. 22, 1922, when change in tariff went into effect.

[2] Includes also imports of antimonial lead, antimonial scrap lead, babbitt metal, solder, etc., beginning Sept. 22, 1922, when change in tariff went into effect, except in 1925, 1926, and 1927, when antimonial lead is excluded.

Lead imported into the United States in ore, base bullion, and refined, by sources 1923–1927, in pounds

[General imports]

Year	Canada	Mexico	South America	Europe	Other countries	Total
1923	11, 399, 671	242, 352, 788	5, 300, 161	11, 004, 938	520, 635	270, 578, 193
1924	11, 022, 091	243, 161, 069	15, 820, 867	4, 857, 805	453, 432	275, 315, 264
1925	11, 646, 820	218, 873, 800	10, 621, 737	1, 594, 963	1, 521, 110	244, 258, 430
1926	12, 316, 740	254, 203, 852	24, 790, 075	3, 224, 504	572, 856	295, 108, 027
1927	6, 214, 867	300, 634, 815	14, 583, 513	1, 226, 049	118, 883	322, 778, 127

Lead imported into the United States, by classes, 1923–1927, in pounds

[General imports]

Year	Lead in ore	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1923	66, 882, 850	161, 496, 495	42, 198, 848	270, 578, 193
1924	95, 320, 168	155, 501, 350	24, 493, 746	275, 315, 264
1925	88, 962, 502	141, 253, 559	14, 042, 369	244, 258, 430
1926	116, 232, 669	156, 570, 738	22, 304, 620	295, 108, 027
1927	81, 276, 126	236, 567, 252	4, 934, 749	322, 778, 127

Lead exported from the United States, 1918–1927, by classes

Year	Pigs and bars				Foreign lead used in articles exported with benefit of drawback [1]	Manufactures of lead from both domestic and foreign ores
	From domestic ore		From foreign ore			
	Pounds	Value	Pounds	Value	Pounds	
1918	83, 662, 322	$5, 889, 381	118, 832, 344	$8, 309, 798	6, 852, 173	$1, 828, 473
1919	21, 019, 605	1, 171, 256	81, 951, 396	4, 536, 273	3, 872, 130	2, 155, 436
1920	5, 459, 713	462, 223	34, 725, 501	2, 570, 535	12, 350, 794	3, 621, 397
1921	3, 247, 294	177, 926	50, 000, 259	2, 284, 107	18, 738, 927	1, 376, 259
1922	11, 645, 821	604, 605	64, 709, 305	3, 177, 360	11, 354, 070	1, 158, 150
1923	3, 997, 485	260, 487	97, 471, 326	5, 195, 256	25, 052, 107	1, 078, 636
1924	10, 664, 083	711, 147	153, 515, 863	9, 685, 619	30, 549, 116	1, 965, 555
1925	9, 910, 955	784, 440	197, 128, 517	14, 910, 891	23, 398, 305	2, 006, 309
1926	8, 551, 639	601, 061	135, 319, 321	8, 904, 603	35, 910, 934	3, 297, 704
1927	5, 066, 035	308, 698	215, 467, 875	12, 508, 566	23, 129, 750	1, 318, 134

[1] Exclusive of lead that entered as pig and was exported in the same form, which would be duplicated in exports of lead from foreign ore.

LIME

Lime sold by producers in the United States, 1918–1927

Year	Hydrated			Total		
	Number of plants in operation	Short tons	Value [1]	Number of plants in operation	Short tons	Value [1]
1918	90	620, 216	$5, 312, 113	496	3, 206, 016	$26, 808, 909
1919	93	777, 408	7, 061, 146	539	3, 330, 347	29, 448, 553
1920	98	853, 116	9, 287, 562	515	3, 570, 141	37, 543, 840
1921	105	792, 970	7, 421, 637	520	2, 532, 153	24, 895, 370
1922	114	1, 106, 063	9, 868, 980	530	3, 639, 617	33, 255, 039
1923	121	1, 225, 928	12, 229, 598	467	4, 076, 243	39, 993, 652
1924	120	1, 316, 664	13, 199, 846	450	4, 072, 000	39, 596, 423
1925	134	1, 560, 848	15, 287, 461	450	4, 580, 823	42, 609, 141
1926	147	1, 606, 811	15, 182, 460	435	4, 560, 398	41, 566, 452
1927	157	1, 596, 906	14, 581, 695	417	4, 414, 932	38, 638, 413

[1] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Lime sold by producers in the United States, 1926 and 1927, by States

State	1926			1927		
	Number of plants in operation	Short tons	Value	Number of plants in operation	Short tons	Value
Alabama	11	220, 732	$1, 721, 558	10	206, 010	$1, 566, 287
Arizona	3	42, 757	421, 549	3	41, 859	390, 074
Arkansas	5	31, 346	275, 935	4	35, 375	307, 335
California	9	67, 421	800, 089	8	64, 934	708, 010
Colorado	4	12, 470	127, 975	4	11, 900	125, 875
Connecticut	6	61, 742	695, 495	6	53, 304	608, 550
Florida	4	9, 424	100, 241	3	5, 317	59, 491
Georgia	1	18, 526	141, 257	1	13, 533	99, 604
Hawaii	1	5, 717	102, 063	1	5, 679	95, 857
Idaho	2	(1)	(1)	2	(1)	(1)
Illinois	12	103, 180	1, 013, 740	10	115, 803	1, 084, 093
Indiana	7	126, 005	970, 624	8	116, 171	830, 527
Iowa	2	(1)	(1)	2	(1)	(1)
Kentucky	3	8, 550	55, 663	3	6, 862	47, 620
Louisiana	1	(1)	(1)			
Maine	4	128, 120	1, 615, 776	5	116, 566	1, 230, 356
Maryland	10	63, 639	524, 242	8	55, 405	439, 457
Massachusetts	10	202, 065	2, 653, 746	10	189, 343	2, 325, 031
Michigan	8	107, 671	995, 123	8	101, 172	931, 597
Minnesota	4	28, 522	296, 068	3	(1)	(1)
Missouri	15	263, 467	2, 218, 943	15	267, 776	2, 189, 420
Montana	3	8, 099	64, 916	3	11, 607	90, 512
Nevada	1	23, 162	239, 469	1	(1)	(1)
New Jersey	1	(1)	(1)	2	(1)	(1)
New Mexico	3	2, 032	20, 479	3	2, 042	20, 480
New York	12	107, 326	1, 016, 647	14	98, 071	905, 116
North Carolina	2	(1)	(1)	1	(1)	(1)
Ohio	31	1, 056, 589	10, 348, 880	31	987, 726	9, 497, 324
Oklahoma	1	257	2, 185	2	(1)	(1)
Oregon	2	785	13, 930	3	1, 105	21, 350
Pennsylvania	133	794, 196	6, 303, 312	122	813, 571	6, 105, 241
Porto Rico	14	7, 116	130, 872	14	7, 516	116, 618
Rhode Island	1	2, 857	42, 535	1	2, 937	43, 342
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	13	173, 363	1, 319, 303	11	181, 385	1, 266, 326
Texas	6	78, 293	706, 153	6	80, 796	733, 678
Utah	10	29, 953	348, 509	10	48, 882	397, 088
Vermont	10	56, 378	677, 944	10	61, 024	683, 440
Virginia	31	188, 696	1, 453, 095	28	178, 426	1, 317, 581
Washington	4	23, 783	298, 014	4	23, 959	382, 294
West Virginia	9	267, 464	1, 719, 590	12	244, 950	1, 643, 109
Wisconsin	23	216, 414	1, 896, 772	22	197, 667	1, 733, 009
Wyoming	1	(1)	(1)	1	30	600
Undistributed		22, 281	233, 760		66, 229	642, 121
	435	4, 560, 398	41, 566, 452	417	4, 414, 932	38, 638, 413

[1] Included under "Undistributed."

Lime imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1918	6, 650	$73, 458	7, 191	$105, 803
1919	8, 679	128, 519	6, 372	108, 370
1920	22, 688	392, 137	5, 921	128, 296
1921	10, 811	234, 798	5, 192	109, 769
1922	14, 112	290, 845	8, 289	116, 649
1923	25, 407	428, 903	11, 789	170, 289
1924	20, 480	377, 994	14, 905	212, 340
1925	15, 323	285, 599	14, 800	218, 696
1926	18, 702	346, 969	12, 960	191, 768
1927	19, 567	356, 836	15, 478	210, 977

LITHIUM MINERALS

Lithium minerals produced in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	5,894	$111,600	1923	2,310	$38,800
1919	6,287	115,000	1924	2,996	62,391
1920	11,696	173,002	1925	3,140	58,500
1921	1,833	33,508	1926	3,700	53,400
1922	2,192	41,300	1927	4,173	59,656

Imports and exports of lithium minerals are not reported separately.

LITHOGRAPHIC STONE

Production of lithographic stone in the United States in 1918 was 6,000 pounds, valued at $350. No domestic production has been reported since 1918.

Lithographic stone imported for consumption in the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918			1923	225,600	$24,861
1919	464,914	$216,293	1924	133,674	9,046
1920	786,119	63,733	1925	186,971	20,268
1921	301,546	34,101	1926	248,698	28,201
1922	256,426	28,242	1927	45,398	6,790

No exports of lithographic stone are reported.

MAGNESITE

Domestic magnesite (expressed as equivalent crude) sold or treated in the United States, 1918–1927

Year	California		Washington		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	84,077	$761,811	147,528	$1,050,790	231,605	$1,812,601
1919	50,020	504,973	106,206	743,442	156,226	1,248,415
1920	81,782	1,083,262	221,985	1,664,888	303,767	2,748,150
1921	47,904	510,177			47,904	510,177
1922	[1] 55,790	[1] 571,745	(1)	(1)	55,790	571,745
1923	73,350	938,600	73,900	165,100	147,250	1,103,700
1924	67,240	901,700	52,860	139,600	120,100	1,041,300
1925	64,600	872,100	56,060	560,600	120,660	1,432,700
1926	53,940	604,130	79,560	596,700	133,500	1,200,830
1927	43,750	507,500	77,740	583,050	121,490	1,090,550

[1] Washington included with California. Bureau of Mines not at liberty to publish figures.

Magnesite imported for consumption in the United States, 1918–1927

Year	Crude		Calcined, not purified	
	Short tons	Value	Short tons	Value
1918	5,432	$103,233	19,049	$821,022
1919	6,381	103,311	9,471	270,723
1920	33,550	106,204	14,780	373,165
1921	51,993	525,452	6,188	230,162
1922	73,331	976,283	72,266	1,207,027
1923	5,182	44,081	72,055	1,022,068
1924	6	84	64,785	1,172,403
1925	487	6,582	[illegible]	1,160,820
1926	608	6,665	91,294	1,448,763
1927	856	8,374	59,203	940,601

Exports are not separately recorded.

MAGNESIUM

Domestic metallic magnesium sold or used in the United States, 1918–1927

Year	Number of producers	Pounds	Value	Year	Number of producers	Pounds	Value
1918	4	284,118	$615,217	1923	2	[1] 125,000	[1] $155,000
1919	3	127,465	247,302	1924	2	[1] 128,000	[1] 150,000
1920	2	(2)	(2)	1925	2	245,000	274,400
1921	1	48,000	86,000	1926	2	322,650	390,400
1922	2	[1] 60,000	[1] 89,000	1927	2	366,400	441,700

[1] Estimate. [2] Bureau of Mines not at liberty to publish figures.

Magnesium imported for consumption in the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918—July to December [1]	11,899	$16,259	1923	13,974	$11,576
1919	13,239	13,583	1924	8,738	6,561
1920	29,275	25,055	1925	8,326	7,070
1921	39,913	30,592	1926	10,117	4,750
1922	182,939	54,448	1927	7,131	8,402

[1] Not separately recorded prior to July, 1918.

Exports are not separately recorded.

MANGANESE

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1918–1927

Year	Ore containing 35 per cent of manganese or more			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value
1918	247	305,869	$8,240,386	110	818,003	$4,445,005	11	236,103	$977,118
1919	42	54,957	1,791,118	24	211,632	965,660	9	112,303	352,570
1920	56	94,420	2,396,235	31	357,279	1,450,518	6	279,687	644,572
1921	14	13,531	495,097	6	8,439	42,755	3	62,670	147,576
1922	18	13,404	455,160	9	344,674	1,071,780	6	251,614	632,039
1923	36	31,500	874,973	41	319,666	1,158,628	12	1,072,457	3,598,327
1924	39	56,515	1,307,477	55	286,470	929,390	12	587,026	1,713,943
1925	42	98,324	1,857,769	53	267,252	915,316	11	1,153,268	2,799,403
1926	34	46,258	1,228,663	54	364,312	1,179,429	8	835,412	1,934,381
1927	39	44,741	1,151,918	47	148,291	673,921	9	1,310,127	3,270,460

Manganese and manganiferous ore (for fluxing purposes) shipped from mines in the United States, 1918–1927

Year	Ore containing 35 per cent of manganese or more		Ore containing 10 to 35 per cent of manganese		Ore containing 5 to 10 per cent of manganese	
	Long tons	Value	Long tons	Value	Long tons	Value
1918	------------	------------	98,160	$158,785	18,196	$54,671
1919	365	$5,745	98,202	216,868	11,596	17,394
1920	------------	------------	123,970	332,615	6,728	10,093
1921	------------	------------	22,962	[1] 57,000	3,028	[1] 7,800
1922	2,278	17,341	27,705	[1] 52,000	1,666	[1] 10,600
1923	769	(2)	40,770	[1 2] 134,133	1,004	[1] 2,510
1924	1,833	(2)	24,972	[1 2] 107,215	------------	------------
1925	------------	------------	25,384	[1] 36,177	2,150	[1] 1,590
1926	------------	------------	17,707	24,679	------------	------------
1927	------------	------------	1,029	[3] 2,635	2,161	(3)

[1] Partly estimated.

[2] Value for 35 per cent ore included with that for 10–35 per cent ore. Bureau of Mines not at liberty to publish figures.

[3] Value for 5–10 per cent ore included with that for 10–35 per cent ore. Bureau of Mines not at liberty to publish figures.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1926 and 1927, by States

State	Ore containing 35 per cent of manganese or more			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 pe cent of manganese		
	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value
1926									
Alabama	2	896	(1)	5	1,018	$6,421			
Arizona	2	2,684	(1)	1	46	(1)			
Arkansas	4	2,450	$64,010	12	8,195	47,428			
California	3	393	8,750						
Colorado				2	2,925	(1)			
Georgia	5	3,251	29,890	17	18,414	121,773	2	6,547	(1)
Idaho:									
Metallurgical	1	800	(1)	2	351	(1)			
Chemical	1	30	(1)						
Massachusetts				1	(1)	(1)			
Michigan				2	107,202	(1)			
Minnesota				2	158,759	(1)	5	799,458	$1,791,350
Montana:									
Metallurgical	3	5,713	44,226						
Chemical	[2] 2	17,904	(1)						
Nevada	1	1,607	(1)	4	12,205	58,941			
New Mexico	1	1,966	(1)	2	52,033	(1)	1	29,407	(1)
North Carolina	1	55	(1)						
Tennessee	2	1,555	(1)	1	953	(1)			
Utah				1	(1)	(1)			
Virginia:									
Metallurgical	4	1,998	40,242	2	2,135	(1)			
Chemical	1	1,794	(1)						
Washington	1	3,162	(1)						
Undistributed			1,041,545		76	914,866			143,031
	34	46,258	1,228,663	54	364,312	1,179,429	8	835,412	1,934,381
1927									
Alabama	2	(1)	(1)	2	(1)	(1)			
Arizona	3	3,905	41,880	1	179	754			
Arkansas	8	2,605	64,202	6	7,444	48,678			
Colorado	1	(1)	(1)	5	26,828	126,938			
Georgia	2	489	(1)	16	20,015	135,606	1	195	(1)
Idaho	1	3,181	50,900						
Massachusetts				1	(1)	(1)			
Michigan				1	14,763	(1)	1	59,976	(1)
Minnesota				1	6,276	22,272	4	934,599	2,169,779
Montana:									
Metallurgical	4	10,124	158,900	1	10,332	(1)			
Chemical	[2] 2	16,382	(1)						
Nevada	3	1,357	16,976	2	3,310	(1)			
New Mexico	3	2,190	37,237	1	56,624	(1)	1	30,710	(1)
Tennessee	3	498	8,182	3	487	3,442			
Utah	1	27	(1)	4	239	(1)			
Virginia:									
Metallurgical	5	2,583	48,860	3	1,029	7,500	1	177	(1)
Chemical	1	629	(1)						
Wisconsin							1	284,470	818,604
Undistributed		771	724,781		765	328,731			282,077
	39	44,741	1,151,918	47	148,291	673,921	9	1,310,127	3,270,460

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[1] Included under "Undistributed."

[2] Figure represents mills through which all shipments were made; individual producers not counted.

Manganiferous iron ore shipped from the Cuyuna district, Minnesota, 1918–1927, in long tons

Year	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese	Year	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese
1918	625, 009	227, 202	1923	253, 634	499, 181
1919	138, 952	98, 220	1924	159, 915	361, 527
1920	293, 524	248, 913	1925	77, 665	741, 409
1921	----------	56, 530	1926	158, 759	799, 458
1922	305, 093	248, 560	1927	6, 276	934, 599

Manganese ore [1] imported for consumption in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	491, 303	$15, 095, 867	1923	[2] 78, 391	$1, 674, 914
1919	333, 344	11, 229, 184	1924	[2] 224, 230	5, 305, 791
1920	606, 937	12, 230, 922	1925	[2] 277, 055	7, 417, 582
1921	401, 354	3, 365, 732	1926	[2] 297, 630	9, 612, 673
1922 [1] Jan. 1-Sept. 21	327, 727	2, 695, 724	1927	[3] 304, 388	9, 271, 920
Sept. 22-Dec. 31	[2] 18, 124	364, 247			

[1] Prior to change in tariff, Sept. 22, 1922, figures represent ore; subsequently, figures represent manganese content of ore.

[2] Includes estimate by the Bureau of Mines for manganese content of ore imported from Cuba. The Bureau of Foreign and Domestic Commerce recorded only gross weight of Cuban ore imported, and the figures for such ore were as follows: 1922 (Sept. 22 to Dec. 31), 190 long tons; 1923, 9,062 tons; 1924, 23,065 tons; 1925, 12,745 tons; 1926, 14,112 tons.

[3] Manganese content of Cuban ore recorded by Bureau of Foreign and Domestic Commerce for 1927 and included in total shown.

No separate record of exports of manganese ore is kept.

MANGANIFEROUS ZINC RESIDUUM

Manganiferous zinc residuum is recovered from roasted franklinite concentrates at Franklin Furnace, N. J. Nearly all of this residuum is reduced to spiegeleisen by the company that produces it. The Bureau of Mines is not at liberty to publish value.

Manganiferous residuum, from zinc roasting in the United States, shipped in 1918–1927, in long tons

1918	146, 796	1923	132, 801
1919	80, 418	1924	119, 457
1920	133, 602	1925	147, 937
1921	12, 627	1926	179, 926
1922	81, 333	1927	(1)

[1] Bureau of Mines not at liberty to publish figures.

MARLS

Calcareous marl sold by producers in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	98, 694	$261, 082	1923	99, 410	$328, 932
1919	91, 437	327, 294	1924	72, 710	225, 383
1920	97, 487	322, 339	1925	68, 670	187, 839
1921	59, 730	195, 743	1926	55, 060	146, 094
1922	67, 777	203, 196	1927	52, 962	180, 166

Greensand marl produced in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	3, 582	$4, 775	1923	10, 656	$131, 123
1919	(1)	(1)	1924	14, 055	151, 205
1920	(1)	(1)	1925	12, 728	179, 788
1921	2, 058	10, 200	1926	12, 681	174, 740
1922	7, 885	56, 800	1927	11, 911	168, 683

[1] Bureau of Mines not at liberty to publish figures.

No imports or exports of marl are reported.

MERCURY

Mercury produced in the United States, 1918–1927

[Flasks of 75 pounds]

Year	Flasks	Value	Year	Flasks	Value
1918	32, 883	$3, 863, 752	1923	7, 937	$521, 302
1919	21, 415	1, 933, 560	1924	10, 085	692, 739
1920	13, 392	1, 066, 807	1925	9, 174	762, 616
1921	6, 339	300, 595	1926	7, 642	702, 323
1922	6, 375	368, 348	1927	11, 276	1, 314, 782

Mercury imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Flasks	Value	Flasks	Value
1918	6, 719	$533, 622	3, 098	$338, 620
1919	10, 635	791, 226	9, 107	817, 328
1920	14, 169	971, 510	1, 553	129, 993
1921	10, 601	457, 993	393	18, 869
1922	16, 920	757, 842	291	15, 910
1923	18, 073	816, 043	318	25, 195
1924	13, 170	566, 820	208	14, 333
1925	20, 855	1, 200, 878	204	15, 930
1926	25, 976	1, 784, 250	116	10, 319
1927	20, 207	1, 780, 134	(1)	(1)

[1] Exports of mercury not separately recorded for 1927.

MICA

Mica [1] sold by producers in the United States, 1918–1927

Year	Sheet mica [1]		Scrap mica		Total [1]	
	Pounds	Value	Short tons	Value	Short tons	Value
1918	1, 644, 200	$731, 810	2, 292	$33, 130	3, 114	$764, 940
1919	1, 545, 709	483, 567	3, 258	58, 084	4, 031	541, 651
1920	1, 683, 480	546, 972	5, 723	167, 017	6, 565	713, 989
1921	741, 845	118, 513	2. 577	56, 849	2, 948	175, 362
1922	1, 077, 968	194, 301	[2] 6, 641	114, 045	[2] 7, 180	308, 346
1923	2, 063, 179	311, 180	[2] 8, 054	129, 695	[2] 9, 086	440, 875
1924	1, 460, 897	212, 035	4, 709	87, 242	5, 439	299, 277
1925	1, 793, 865	321, 962	9, 695	173, 537	10, 592	495, 499
1926	2, 172, 159	400, 184	7, 043	136, 643	8, 129	536, 827
1927	1, 512, 492	212, 482	6, 280	110, 139	7, 036	322, 621

[1] For 1920 and later years the figures for sheet mica represent uncut sheet exclusively; for earlier years some cut sheet was included.

[2] Includes mica derived from mica schist.

Mica imported for consumption in the United States, 1918–1927

Year	Sheet				Ground		Total	
	Unmanufactured		Cut and splittings					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1918	741, 429	$658, 576	(1)	$880, 906	11, 587	$1, 647	(1)	$1, 541, 129
1919	723, 713	726, 532	(1)	762, 228	62	9	(1)	1, 488, 769
1920	1, 298, 537	1, 177, 943	(1)	2, 011, 434			(1)	3, 189, 377
1921	328, 444	331, 219	(1)	758, 521	134, 650	2, 166	(1)	1, 091, 906
1922	385, 653	359, 793	(1)	[2] 966, 315	313, 745	4, 514	(1)	1, 330, 622
1923	1, 044, 366	532, 375	[3] 4, 419, 102	[3] 1, 844, 149	1, 867, 385	28, 324	7, 330, 853	2, 404, 848
1924	671, 793	419, 154	[3] 3, 787, 251	[3] 1, 885, 718	1, 342, 107	22, 034	5, 801, 151	2, 326, 906
1925	604, 550	526, 292	[3] 3, 346, 144	[3] 1, 259, 415	950, 614	13, 120	4, 901, 308	1, 798, 827
1926	818, 381	562, 300	[3] 5, 358, 983	[3] 1, 886, 486	140, 732	2, 048	6, 318, 096	2, 450, 834
1927	776, 307	399, 302	[3] 2, 683, 340	[3] 1, 231, 007			3, 459, 647	1, 630, 309

[1] Quantity not reported.

[2] Includes also value of "built up, washers, and other manufactures" ($20,899) imported Sept. 22 to Dec. 31. Not separately classified prior to change in tariff.

[3] Composed of following: 1923, "Cut mica" 60,135 pounds, $49,268; "splittings" 4,301,727 pounds, $1,730,532; "built up" 30,032 pounds, $37,382; and "washers and other" 27,208 pounds, $26,967; 1924, "Cut mica" 74,534 pounds, $69,018; "splittings" 3,619,229 pounds, $1,681,774; "built up" 18,205 pounds, $41,455; and "washers and other" 75,283 pounds, $93,471; 1925, "Cut mica" 41,284 pounds, $63,466; "splittings" 3,239,554 pounds, $1,113,202; "built up" 14,639 pounds, $16,785; and "washers and other" 50,667 pounds, $65,962; 1926, "Cut mica" 46,662 pounds, $44,621; "splittings" 5,229,858 pounds, $1,750,434; "built up" 15,147 pounds, $15,410; and "washers and other" 67,316 pounds, $76,021; 1927, "Cut mica" 64,075 pounds, $75,469; "splittings" 2,588,253 pounds, $1,123,808; "built up" 8,097 pounds, $9,211; and "washers and other" 22,915 pounds, $22,519.

Value of mica exported from the United States, 1918–1927

1918	$74, 529	1923	$182, 162
1919	109, 348	1924	169, 741
1920	316, 169	1925	198, 596
1921	153, 990	1926	230, 511
1922	129, 186	1927	207, 263

MILLSTONES

[See Abrasive materials]

MINERAL PAINTS

Domestic zinc and lead pigments,[1] made in large part direct from ores in the United States, sold by producers, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	135, 746	$26, 464, 590	1923	163, 240	$23, 660, 381
1919	155, 648	25, 810, 671	1924	173, 859	25, 711, 159
1920	143, 244	24, 564, 572	1925	199, 190	28, 310, 631
1921	102, 463	14, 801, 032	1926	184, 289	25, 896, 269
1922	162, 815	22, 205, 400	1927	191, 853	25, 275, 975

[1] Include sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

The canvass of natural mineral pigments was discontinued after 1915. Iron ore sold for paint, 1918 to 1927, is shown below.

Iron ore sold for paint, by producers, in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	10, 034	$22, 924	1923	27, 823	$140, 306
1919	17, 885	84, 630	1924	23, 106	103, 626
1920	27, 382	112, 364	1925	29, 704	140, 986
1921	11, 624	56, 824	1926	23, 707	129, 541
1922	30, 668	166, 682	1927	25, 023	132, 007

MINERAL WATERS

Natural mineral waters sold by producers in the United States, 1918–1923 [1]

Year	Gallons	Value	Year	Gallons	Value
1918	40,709,722	$4,533,001	1921	34,781,238	$4,879,445
1919	38,697,280	4,880,186	1922	38,492,881	5,498,259
1920	36,218,260	4,860,915	1923	44,430,908	6,493,177

[1] Canvass discontinued after 1923.

Mineral waters (natural and artificial) imported for consumption in the United States, 1918–1927

Year	Gallons	Value	Year	Gallons	Value
1918	489,487	$241,641	1923	722,657	$279,875
1919	203,014	116,948	1924	758,771	323,908
1920	527,114	203,901	1925	794,593	354,411
1921	524,765	167,101	1926	807,038	360,221
1922	698,751	269,245	1927	1,000,038	500,757

Large quantities of a few domestic waters are exported, but no figures are availabe prior to 1922. Exports of natural and artificial mineral waters have been as follows: 1922, 209,219 gallons, valued at $169,473; 1923, 227,831 gallons, $193,248; 1924, 221,203 gallons, $179,418; 1925, 206,754 gallons, $178,828; 1926, 255,860 gallons, $191,798; 1927, 197,978 gallons, $173,145.

MOLYBDENUM

Molybdenum in ore and concentrates, produced in the United States, sold in 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	861,637	$1,253,700	1923	22,667	(1)
1919	297,926	341,814	1924	297,174	(1)
1920	34,900	17,207	1925	1,154,050	[2] $961,324
1921	----------	----------	1926	(3)	(3)
1922	----------	----------	1927	2,286,075	1,858,786

[1] Value not reported.
[2] Estimate by Bureau of Mines.
[3] Bureau of Mines not at liberty to publish figures.

"Molybdenum ore [1] (steel-hardening)" imported for consumption in the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918—July to December [2]	[3] 140,222	$123,924	1923	[4] 16,071	$13,435
1919	[3] 106,743	77,572	1924	[4] 10,370	8,068
1920	[3] 15,639	9,707	1925	[4] 1,954	1,763
1921	[3] 29,783	20,471	1926	[4] 18,367	11,175
1922	[3] 412,221	90,015	1927	[4] 12,341	16,472

[1] Prior to Sept. 22, 1922, imports recorded as ore; beginning with change in tariff, recorded as molybdenum content of ore.
[2] Not separately classified prior to July, 1918.
[3] Recorded as molybdenum ore.
[4] Recorded as molybdenum content of ore.

For imports of ferromolybdenum, see under Ferro-alloys. Exports of ferromolybdenum are not separately classified.

MONAZITE

[See Thorium minerals]

NICKEL

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1918–1927, and from mixed ores in 1919 and 1920

Year	Short tons	Value	Year	Short tons	Value
1918	441	$401,000	1923	100	$71,605
1919 [1]	511	434,485	1924	191	114,903
1920 [1]	365	293,250	1925	272	169,664
1921	111	86,000	1926	323	234,558
1922	208	133,191	1927	860	390,740

[1] Including nickel produced from copper-lead-cobalt-nickel ores mined in Missouri.

Secondary nickel recovered as metal and in nonferrous alloys and salts in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	1,393	$1,532,300	1923	1,550	$1,109,800
1919	2,447	1,829,400	1924	2,240	1,227,500
1920	2,200	1,733,600	1925	2,300	1,518,000
1921	945	680,400	1926	3,050	2,135,000
1922	1,512	967,700	1927	3,380	2,366,000

Value of nickel imported for consumption in the United States, 1918–1927

Year	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.	Manufactures and nickel sheets and strips	Total
1918	$11,520,826	$115,243	$11,636,069
1919	8,334,564	90,451	8,425,015
1920	10,657,523	200,464	10,857,987
1921	1,220,347	107,155	1,327,502
1922	3,945,309	110,176	4,055,485
1923	6,602,096	94,832	6,696,928
1924	6,132,984	70,755	6,203,739
1925	7,772,320	98,761	7,871,081
1926	9,409,567	65,166	9,474,733
1927	8,802,075	111,816	8,913,891

Nickel imported for consumption in the United States, 1926 and 1927, by classes

Class	1926		1927	
	Pounds	Value	Pounds	Value
Unmanufactured:				
Nickel ore and matte	14,635,651	$1,303,003	10,744,474	$902,272
Nickel alloys, pigs, bars, etc	29,408,950	7,865,493	29,219,779	7,720,885
Nickel oxide	1,485,386	241,071	1,013,332	178,803
Nickel silver or German silver	----------	----------	232	115
Manufactured:				
Nickel silver or German silver in sheets, strips, and rods	6,476	4,743	16,522	12,047
All other manufactures of nickel	42,293	60,423	----------	99,769
	----------	9,474,733	----------	8,913,891

Nickel, nickel oxide, and matte exported from the United States, 1918–1927 [1]

Year	Pounds	Value	Year	Pounds	Value
1918	17,469,500	$6,927,041	1921	425,851	$103,372
1919	3,810,656	1,697,544	1922	9,317,520	1,016,091
1920	1,215,232	574,845	1923 [2]	11,200	626

[1] Not separately classified after 1923.
[2] Nickel oxide and matte only. Separate figures for nickel not available.

Nickel exported from the United States, 1926 and 1927, by classes

Class	1926		1927	
	Pounds	Value	Pounds	Value
Nickel Monel metal and other alloys	1,598,538	$428,820	2,108,435	$601,182
Manufactures	(1)	575,048	(1)	787,767
Nickel silver or German silver in bars, rods, or sheets	1,539,480	336,265	1,424,268	319,059

[1] Quantity not recorded.

OILSTONES AND SCYTHESTONES

[See Abrasive materials]

ORE

Crude metallic ores (including tailings, etc.) shipped from or treated at the mine in the United States, 1922–1927, in short tons

[Figures rounded]

Class of ore	1922	1923	1924	1925	1926	1927
Aluminum ore (bauxite)	347,000	585,000	389,000	355,000	439,000	359,000
Chromite	400	250	320	120	160	220
Dry and siliceous (gold and silver) ore	8,728,000	9,122,000	8,979,000	8,995,000	8,743,000	8,550,000
Iron ore [1]	56,641,000	78,092,000	58,298,000	71,557,000	77,550,000	68,561,000
Manganese ore (35 per cent or more Mn) [1]	15,000	35,000	63,000	110,000	52,000	50,000
Manganiferous ore (5 to 35 per cent Mn) [1]	668,000	1,559,000	978,000	1,591,000	1,344,000	1,633,000
Mercury ore	43,000	51,000	70,000	65,000	51,000	(2)
Copper ore:						
Western States	21,383,000	39,433,000	43,344,000	45,430,000	49,356,000	48,106,000
Central States	4,952,000	5,363,000	5,373,000	7,037,000	7,642,000	8,046,000
Eastern States	558,000	777,000	715,000	795,000	638,000	674,000
	26,893,000	45,573,000	49,432,000	53,262,000	57,636,000	56,826,000
Copper-lead and copper-lead-zinc ore	52,000	162,000	220,000	229,000	282,000	419,000
Lead ore:						
Western States	2,124,000	2,288,000	2,359,000	2,271,000	2,024,000	2,005,000
Central States	5,162,000	5,320,000	6,205,000	6,287,000	6,330,000	6,344,000
Eastern States	2,000	5,500	5,000	2,000	4,000	
	7,288,000	7,613,000	8,569,000	8,560,000	8,358,000	8,349,000
Lead-zinc ore:						
Western States	445,000	1,204,000	1,792,000	2,704,000	3,461,000	3,135,000
Central States	8,110,000	9,783,000	11,493,000	14,917,000	15,488,000	11,310,000
Eastern States			71,000	120,000	144,000	202,000
	8,555,000	10,987,000	13,356,000	17,741,000	19,093,000	14,647,000
Zinc ore:						
Western States	471,000	724,000	146,000	169,000	215,000	452,000
Central States	1,206,000	2,154,000	1,639,000	1,674,000	2,806,000	5,177,000
Eastern States	990,000	1,186,000	1,375,000	1,568,000	1,118,000	1,194,000
	2,667,000	4,064,000	3,160,000	3,411,000	4,139,000	6,823,000
Grand total	111,897,000	157,843,000	143,514,000	165,876,000	177,687,000	166,217,000

[1] Exclusive of fluxing ore.
[2] Figures not available.

PEAT

Peat produced in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	107,261	$1,047,243	1923	61,355	$376,534
1919	69,197	705,532	1924	55,469	345,470
1920	73,264	921,732	1925	72,436	452,995
1921	30,406	260,119	1926	61,936	384,413
1922	61,080	397,729	1927	(1)	(1)

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[1] No canvass.

Peat moss imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918			1923	5,973	$43,184
1919	464	$16,345	1924	5,541	47,208
1920	2,762	38,201	1925	10,233	121,719
1921	3,450	22,754	1926	16,669	174,241
1922	4,805	33,034	1927	31,595	326,549

PETROLEUM AND PETROLEUM PRODUCTS

CRUDE PETROLEUM

Crude petroleum produced in the United States, 1918–1927

[Barrels of 42 U. S. gallons]

Year	Barrels	Value at wells	Year	Barrels	Value at wells
1918	355,928,000	$703,944,000	1923	732,407,000	$978,430,000
1919	378,367,000	760,266,000	1924	713,940,000	1,022,683,000
1920	442,929,000	1,360,745,000	1925	763,743,000	1,284,960,000
1921	472,183,000	814,745,000	1926	770,874,000	1,447,760,000
1922	557,531,000	895,111,000	1927	901,129,000	1,172,830,000

Crude petroleum produced in the United States, 1925–1927, by fields and States

	1925		1926		1927	
	Barrels	Value at wells	Barrels	Value at wells	Barrels	Value at wells
FIELD						
Appalachian	27,610,000	$85,440,000	28,572,000	$89,820,000	30,454,000	$76,880,000
Lima-Indiana	2,120,000	4,580,000	2,030,000	4,710,000	1,835,000	3,200,000
Illinois and southwestern Indiana	8,512,000	16,480,000	8,418,000	18,660,000	7,720,000	12,900,000
Michigan	4,000	10,000	94,000	253,000	439,000	832,000
Mid-Continent	424,331,000	732,930,000	423,867,000	851,600,000	546,987,000	708,940,000
Gulf coast	33,112,000	53,360,000	45,275,000	67,600,000	52,069,000	67,250,000
Rocky Mountain [1]	35,554,000	61,516,000	[1]37,945,000	[1]69,570,000	[1]30,429,000	[1]42,035,000
California	232,492,000	330,610,000	224,673,000	345,547,000	231,196,000	260,735,000
Other fields [2]	8,000	34,000	(1)	(1)	(1)	(1)
	763,743,000	1,284,960,000	770,874,000	1,447,760,000	901,129,000	1,172,830,000
STATE						
Alaska	8,000	34,000	7,600	9,600	[3]7,000	[3]33,000
Arkansas	77,398,000	68,880,000	58,332,000	64,600,000	40,005,000	42,400,000
California	232,492,000	330,610,000	224,673,000	345,547,000	231,196,000	260,735,000
Colorado	1,226,000	1,810,000	2,768,000	5,100,000	2,831,000	3,400,000
Illinois	7,863,000	15,235,000	7,760,000	17,200,000	6,994,000	11,700,000
Indiana	829,000	1,615,000	808,000	1,770,000	852,000	1,390,000
Kansas	38,357,000	74,410,000	41,498,000	93,800,000	41,069,000	58,300,000
Kentucky	6,759,000	15,682,000	6,274,000	15,250,000	6,719,000	11,220,000
Louisiana	20,272,000	32,500,000	23,201,000	38,200,000	22,818,000	29,740,000
Michigan	4,000	10,000	94,000	253,000	439,000	832,000
Montana	4,091,000	6,420,000	7,727,000	10,170,000	5,058,000	7,090,000
New Mexico	1,060,000	1,815,000	1,666,000	3,270,000	1,226,000	1,630,000
New York	1,695,000	6,270,000	1,956,000	7,200,000	2,242,000	7,110,000
Ohio	7,212,000	18,280,000	7,272,000	19,180,000	7,593,000	14,970,000
Oklahoma	176,768,000	348,230,000	179,195,000	413,900,000	277,775,000	397,200,000
Pennsylvania	8,097,000	29,310,000	8,961,000	31,930,000	9,526,000	29,150,000
Tennessee	24,000	53,000	43,000	100,000	60,000	90,000
Texas	144,648,000	262,270,000	166,916,000	308,700,000	217,389,000	248,550,000
Utah	4,000	4,000	525	656	(3)	(3)
West Virginia	5,763,000	20,055,000	5,946,000	20,560,000	6,023,000	17,410,000
Wyoming	29,173,000	51,467,000	25,776,000	51,020,000	21,307,000	29,830,000
	763,743,000	1,284,960,000	770,874,000	1,447,760,000	901,129,000	1,172,830,000

[1] Production of Alaska included with Rocky Mountain for 1926 and 1927.

[2] Alaska

[3] Utah included with Alaska.

Stocks of crude petroleum held in the United States on December 31, 1926 and 1927, in barrels

		1926	1927
East of California:			
At refineries, by location of storage—			
East coast—			
Domestic		7, 240, 000	8. 690, 000
Foreign		2, 186, 000	2, 768, 000
Appalachian		1, 673, 000	1, 871, 000
Indiana, Illinois, etc		2, 224, 000	2, 777, 000
Oklahoma, Kansas, etc		2, 926, 000	4, 871, 000
Texas—			
Inland		952, 000	1, 432, 000
Gulf coast—			
Domestic		8, 194, 000	7, 686, 000
Foreign		236, 000	219, 000
Arkansas and inland Louisiana		601, 000	408, 000
Louisiana, Gulf coast—			
Domestic		7, 019, 000	6, 149, 000
Foreign		802, 000	1, 046, 000
Rocky Mountain		1, 422, 000	1, 400, 000
Total at refineries		35, 475, 000	39, 317, 000
Pipe-line and tank-farm stocks—			
Domestic petroleum, by field of origin—			
Appalachian—			
New York, Pennsylvania, West Virginia, eastern and central Ohio	gross	6, 855, 000	6, 621, 000
	net	6, 570, 000	6, 294, 000
Kentucky	gross	1, 350, 000	1, 168, 000
	net	1, 220, 000	1, 040, 000
Lima-Indiana	gross	877, 000	1, 287, 000
	net	666, 000	1, 134, 000
Illinois-southwestern Indiana	gross	12, 255, 000	12, 664, 000
	net	11, 770, 000	12, 170, 000
Mid-Continent—			
Oklahoma, Kansas, north, central, western, and Panhandle Texas	gross	154, 558, 000	234, 420, 000
	net	142, 208, 000	221, 466, 000
North Louisiana and Arkansas	gross	34, 318, 000	28, 174, 000
	net	31, 640, 000	25, 373, 000
Gulf coast	gross	20, 430, 000	18, 365, 000
	net	20, 031, 000	17, 922, 000
Rocky Mountain	gross	28, 129, 000	27, 281, 000
	net	28, 075, 000	27, 238, 000
Total pipe-line and tank-farm	gross	258, 772, 000	329, 980, 000
	net	242, 180, 000	312, 637, 000
Foreign crude petroleum held in United States by importers—			
At Atlantic coast stations		165, 000	46, 000
At Gulf coast stations		444, 000	38, 000
Total		609, 000	84, 000
Producers' stocks		5, 904, 000	7, 536, 000
Total crude stocks east of California		284, 168, 000	359, 574, 000
California:			
Light		30, 861, 000	20, 086, 000
Heavy (including fuel oil)		88, 309, 000	93, 719, 000

Indicated deliveries of crude petroleum (exclusive of California grades) to consumers in the United States, 1925–1927, in barrels [1]

	1925	1926	1927
Domestic petroleum (by field of origin):			
Appalachian	28, 397, 000	29, 343, 000	30, 915, 000
Lima-Indiana	2, 374, 000	2, 338, 000	1, 366, 000
Michigan	4, 000	94, 000	435, 000
Illinois and southwestern Indiana	8, 811, 000	7, 241, 000	7, 317, 000
Mid-Continent	439, 742, 000	447, 713, 000	471, 941, 000
Gulf coast	34, 004, 000	44, 484, 000	54, 479, 000
Rocky Mountain [2]	35, 310, 000	38, 709, 000	31, 391, 000
Deliveries and exports	548, 642, 000	569, 922, 000	597, 844, 000
Exports	10, 153, 000	10, 022, 000	10, 587, 000
Deliveries	538, 489, 000	559, 900, 000	587, 257, 000
Foreign petroleum	61, 941, 000	60, 179, 000	58, 908, 000
	600, 430, 000	620, 079, 000	646, 165, 000

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[1] Indicated deliveries equal production plus imports plus stocks, exclusive of refinery stocks, at beginning of period minus exports and stocks at end of period.

[2] Alaska included with Rocky Mountain.

Crude petroleum imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports			
			Domestic petroleum		Foreign petroleum [1]	
	Barrels	Value	Barrels	Value	Barrels	Value
1918	37, 735, 641	$21, 319, 464	4, 900, 691	$12, 084, 250	32	$201
1919	52, 821, 567	26, 442, 881	5, 924, 320	14, 805, 546	94, 331	42, 520
1920	106, 175, 289	55, 799, 254	8, 044, 907	28, 990, 444	712, 185	996, 430
1921	125, 363, 983	66, 547, 379	8, 865, 497	20, 204, 491	74, 136	57, 407
1922	127, 308, 423	70, 383, 309	9, 995, 093	18, 348, 110	167, 724	74, 121
1923	82, 015, 025	53, 882, 259	17, 060, 771	23, 111, 832	324, 607	150, 358
1924	77, 775, 173	73, 841, 507	17, 604, 877	26, 495, 011	367, 662	165, 401
1925	61, 824, 242	75, 406, 956	13, 125, 157	24, 274, 905	209, 950	94, 372
1926	60, 382, 329	79, 307, 877	15, 406, 045	28, 495, 773	1, 353	4, 436
1927	58, 382, 632	78, 609, 117	15, 843, 405	25, 944, 489	241	333

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[1] Exports of refined products and shipments of crude petroleum to Alaska, Hawaii, Porto Rico, and the Philippine Islands are not included.

PETROLEUM PRODUCTS

Crude petroleum run to stills and chief petroleum products produced at refineries in the United States, 1918–1927, in barrels

Year	Crude petroleum run to stills		Chief petroleum products			
	Domestic	Foreign	Gasoline	Kerosene	Gas and fuel oils	Lubricants
1918	326, 025, 000		85, 007, 000	43, 461, 000	174, 319, 000	20, 035, 000
1919	361, 520, 000		94, 235, 000	55, 753, 000	181, 602, 000	20, 161, 000
1920	433, 915, 000		116, 251, 000	55, 240, 000	210, 987, 000	24, 938, 000
1921	443, 363, 000		122, 704, 000	46, 313, 000	230, 091, 000	20, 896, 000
1922	425, 823, 000	74, 883, 000	147, 672, 000	54, 913, 000	254, 910, 000	23, 304, 000
1923	538, 252, 000	42, 986, 000	179, 903, 000	55, 927, 000	287, 481, 000	26, 128, 000
1924	597, 954, 000	45, 765, 000	213, 326, 000	60, 026, 000	320, 476, 000	27, 498, 000
1925	698, 582, 000	41, 338, 000	259, 601, 000	59, 689, 000	364, 991, 000	31, 055, 000
1926	734, 301, 000	44, 963, 000	299, 734, 000	61, 768, 000	365, 195, 000	32, 293, 000
1927	778, 729, 000	50, 106, 000	330, 435, 000	56, 113, 000	393, 066, 000	31, 721, 000

Chief petroleum products imported for consumption in the United States, 1918–1927, in barrels

Year	Gasoline	Kerosene	Gas and fuel oils	Lubricants
1918	307, 127	(1)	(1)	(1)
1919	202, 861	(1)	(1)	(1)
1920	963, 764	(1)	(1)	(1)
1921	900, 381	(1)	(1)	(1)
1922	1, 479, 319	[2] 3, 487	[2] 2, 947, 102	[2] 43, 057
1923	4, 555, 084	7, 178	12, 286, 260	29, 027
1924	3, 452, 923	9, 942	12, 926, 837	10, 761
1925	3, 812, 790	19, 281	12, 245, 468	37, 475
1926	5, 539, 585	74, 097	14, 432, 175	33, 018
1927	5, 002, 306	55, 435	8, 124, 192	7, 944

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(1) Not separately classified prior to Sept. 22, 1922.
[2] Figures cover Sept. 22 to Dec. 31, 1922; not separately classified prior to change in tariff.

Chief petroleum products exported from the United States, 1918–1927, in barrels

Year	Gasoline	Kerosene	Gas and fuel oils	Lubricants
1918	13,318,306	11,693,091	28,589,293	6,126,601
1919	8,860,309	23,313,218	13,924,991	6,542,742
1920	15,269,280	20,730,120	19,704,625	9,574,320
1921	12,692,270	17,832,693	20,120,493	6,888,491
1922	13,787,191	21,315,015	16,600,462	7,889,516
1923	20,135,567	20,188,796	29,252,245	8,295,726
1924	28,246,078	21,817,890	34,292,709	9,030,944
1925	30,637,804	21,074,667	32,508,547	9,596,484
1926	42,479,876	22,016,214	34,516,390	9,265,781
1927	43,334,164	19,352,102	42,963,180	9,686,361

PHOSPHATE ROCK

Phosphate rock sold or used by producers in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	2,490,760	$8,214,463	1923	3,006,706	$11,576,049
1919	2,271,983	11,591,268	1924	2,867,789	10,252,083
1920	4,103,982	25,079,572	1925	3,481,819	11,545,678
1921	2,064,025	12,270,070	1926	3,209,976	10,893,800
1922	2,417,883	10,482,846	1927	3,170,699	11,253,352

Phosphate rock imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value
1918			143,455	$912,485
1919	34	$457	378,731	3,567,982
1920	63	2,090	1,069,712	10,570,175
1921	3,535	43,960	733,312	7,320,137
1922	5,890	95,846	719,294	5,858,167
1923	6,725	92,263	827,551	5,772,171
1924	16,098	181,515	818,773	5,120,832
1925	2,735	37,932	870,200	5,677,763
1926	17,378	192,611	748,963	4,435,590
1927	28,195	292,871	918,211	4,731,562

PLATINUM AND ALLIED METALS

Reports received from refiners of crude platinum, gold bullion, and copper indicate that 46,050 troy ounces of refined new metals of the platinum group were recovered in 1927, of which 8,173 ounces are believed to be of domestic origin.

New platinum and allied metals recovered by refiners in the United States, 1918–1927, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Other	Total
1918	54,399	4,024	465	539	326	59,753
1919	40,220	3,807	401	402	279	45,109
1920	36,015	4,309	418	409	393	41,544
1921	51,791	2,686	286	581	1,026	56,370
1922	54,142	1,943	210	1,301	122	57,718
1923	46,780	1,934	280	787	16	49,797
1924	57,827	6,065	680	1,261	174	66,007
1925	41,300	7,358	283	648	54	49,643
1926	76,154	6,437	234	2,113	43	84,981
1927	41,121	3,879	256	631	163	46,050

Dealers and refiners reported recovery in 1927 of 53,072 ounces of secondary platinum metals derived from refining scrap metal, sweeps, and other waste products of manufacture that contain platinum. Although the figures that make up this total undoubtedly contain some duplication, it is believed that they are worth publishing.

Secondary platinum and allied metals recovered in the United States, 1918–1927, in troy ounces

Year	Platinum	Palladium	Iridium	Other	Total
1918	40, 378	1, 795	3, 410		45, 583
1919	54, 545	3, 467	3, 504		61, 516
1920	51, 255	3, 100	3, 355		57, 710
1921	39, 131	4, 887	1, 776	229	46, 023
1922	40, 062	4, 193	1, 937	496	46, 688
1923	39, 152	6, 246	2, 021	453	47, 872
1924	45, 474	5, 784	2, 200	1, 013	54, 471
1925	35, 578	4, 680	1, 827	1, 189	43, 274
1926	38, 795	5, 647	1, 478	217	46, 137
1927	46, 127	4, 244	1, 810	891	53, 072

Platinum and allied metals imported for consumption in the United States, 1918–1927

Year	Troy ounces	Value	Year	Troy ounces	Value
1918	56, 756	$5, 167, 908	1923	106, 637	$10, 466, 705
1919	68, 054	6, 747, 447	1924	111, 359	11, 050, 349
1920	100, 546	10, 617, 440	1925	125, 802	13, 230, 148
1921	78, 378	5, 418, 464	1926	134, 797	13, 451, 835
1922	110, 025	8, 983, 547	1927	148, 769	12, 413, 494

Platinum and allied metals imported for consumption in the United States, 1926 and 1927, by metals

Metal	1926		1927	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)	1, 221	$124, 668		
Grains, nuggets, sponge, or scrap	87, 162	8, 683, 359	90, 491	$7, 480, 869
Ingots, bars, sheets or plates, not less than one-eighth inch thick	26, 585	2, 995, 582	38, 053	3, 707, 062
	114, 968	11, 803, 609	128, 544	11, 187, 931
Manufactures of, except jewelry	5	646	37	5, 812
Iridium	3, 305	411, 646	4, 633	520, 202
Osmiridium	684	64, 714	7, 506	397, 408
Osmium	5, 457	594, 042	6	277
Palladium	8, 258	460, 015	6, 251	222, 878
Rhodium	1, 362	78, 907	1, 308	59, 940
Ruthenium	758	38, 256	484	19, 046
	134, 797	13, 451, 835	148, 769	12, 413, 494

Platinum exported from the United States, 1918–1927

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1918	119	$13, 511	(1)	$23, 562
1919	522	75, 066	(1)	54, 529
1920	1, 302	177, 115	(1)	111, 014
1921	3, 272	244, 473	741	85, 216
1922 Crude, scrap, and old	143	13, 149	486	35, 967
1922 Ingots, sheets, wire, and alloys	1, 313	127, 047		
1923	1, 151	128, 599	592	65, 073
1924	5, 854	643, 282	1, 274	136, 948
1925	16, 234	1, 787, 122	3, 537	249, 975
1926	11, 573	1, 253, 795	1, 898	160, 648
1927	19, 923	1, 577, 560	1, 549	128, 875

[1] Quantity not recorded.

POTASH

Crude potassium salts produced and sold in the United States, 1918–1927

Year	Produced			Sold		
	Number of plants	Gross weight (short tons)	K_2O content (short tons)	Gross weight (short tons)	K_2O content (short tons)	Value f. o. b. plant
1918	128	207, 686	54, 803	140, 343	38, 580	$15, 839, 618
1919	102	116, 634	32, 474	166, 063	45, 728	11, 271, 269
1920	66	166, 834	48, 077	139, 963	41, 444	7, 463, 026
1921	20	25, 485	10, 171	10, 337	4, 408	447, 859
1922	12	25, 176	11, 714	22, 028	11, 313	463, 512
1923	12	39, 029	20, 215	35, 164	19, 281	784, 671
1924	12	43, 734	22, 903	37, 492	21, 880	842, 618
1925	9	51, 565	25, 448	52, 823	25, 802	1, 204, 024
1926	7	46, 324	23, 366	51, 369	25, 060	1, 083, 064
1927	9	76, 819	43, 510	94, 722	49, 500	2, 448, 146

Potash materials imported for consumption in the United States, 1918–1927

Year	Potassium salts used mainly in the fertilizer industry [1]			Potassium salts used mainly in chemical industries [2]			Total		
	Short tons		Value	Short tons		Value	Short tons		Value
	Gross weight	K_2O content		Gross weight	K_2O content		Gross weight	K_2O content	
1918	525	261	$117, 438	23, 894	7, 696	$8, 790, 398	24, 419	7, 957	$8, 907, 836
1919	127, 416	28, 484	4, 163, 739	33, 430	11, 135	6, 028, 077	160, 846	39, 619	10, 191, 816
1920	918, 698	197, 795	33, 885, 627	63, 564	26, 997	9, 504, 156	982, 262	224, 792	43, 389, 783
1921	212, 752	64, 126	7, 743, 364	32, 453	14, 572	3, 739, 090	245, 205	78, 698	11, 482, 454
1922	632, 711	186, 264	10, 951, 197	34, 198	15, 151	4, 415, 891	666, 909	201, 415	15, 367, 088
1923	712, 701	194, 210	10, 633, 475	35, 824	15, 740	4, 771, 097	748, 525	209, 950	15, 404, 572
1924	663, 914	187, 079	10, 042, 575	28, 336	13, 286	3, 325, 552	692, 250	200, 365	13, 368, 127
1925	892, 684	239, 167	12, 730, 019	44, 429	19, 050	4, 641, 747	937, 113	258, 217	17, 371, 766
1926	859, 422	245, 700	13, 635, 154	47, 941	20, 580	4, 796, 711	907, 363	266, 280	18, 431, 865
1927	687, 349	205, 818	13, 178, 610	43, 248	19, 155	5, 191, 195	730, 597	224, 973	18, 369, 805

[1] Includes kainite, manure salts, muriate, and sulphate. Considerable quantities of muriate and some sulphate were used in chemical industries.

[2] Includes bicarbonate, bichromate, bitartrate, bromide, carbonate, caustic, chlorate, chromate, cyanide, ferricyanide, ferrocyanide, iodide, nitrate, perchlorate, permanganate, and Rochelle salt.

Domestic potassium salts exported from the United States, 1918–1927

Year	Gross weight (short tons)	Value	Year	Gross weight (short tons)	Value
1918	(1)	$1, 372, 170	1923	3, 997	$505, 837
1919	(1)	2, 755, 544	1924	1, 923	301, 036
1920	(1)	3, 562, 015	1925	2, 155	398, 740
1921	(1)	335, 993	1926	1, 679	319, 201
1922	6, 238	780, 996	1927	1, 965	487, 726

[1] Figures not available.

PUMICE

[See Abrasive materials]

PYRITES

Pyrites produced in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	464, 494	$2, 644, 515	1923	181, 628	$661, 000
1919	420, 647	2, 558, 172	1924	160, 096	645, 262
1920	310, 777	1, 596, 961	1925	170, 081	650, 448
1921	157, 118	711, 432	1926	166, 559	616, 668
1922	169, 043	671, 241	1927	215, 786	804, 006

Pyrites containing more than 25 per cent of sulphur imported for consumption in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	496, 792	$2, 741, 676	1923	263, 695	$1, 254, 389
1919	388, 973	2, 176, 565	1924	246, 737	598, 544
1920	332, 606	1, 660, 832	1925	276, 385	773, 925
1921	216, 229	818, 852	1926	366, 151	856, 981
1922	279, 445	1, 199, 076	1927	250, 794	647, 512

Exports of "pyrites or other sulphur ore" in 1922 amounted to 323 long tons, valued at $4,325. Data for other years are not separately shown.

QUARTZ

[See under Silica]

QUICKSILVER

[See Mercury]

RADIUM

[See Uranium and vanadium ores]

RUTILE

[See Titanium minerals]

SALT

Salt sold or used by producers in the United States, 1918–1927

Year	Short tons				Total value
	Manufactured (evaporated)	In brine	Rock salt	Total	
1918	2, 724, 203	2, 830, 600	1, 683, 941	7, 238, 744	$26, 940, 361
1919	2, 392, 290	2, 850, 639	1, 639, 973	6, 882, 902	27, 074, 694
1920	2, 409, 924	2, 819, 916	1, 610, 189	6, 840, 029	29, 894, 075
1921	1, 931, 243	1, 577, 335	1, 472, 576	4, 981, 154	24, 557, 966
1922	2, 276, 683	2, 569, 042	1, 947, 124	6, 792, 849	27, 464, 838
1923	2, 239, 872	2, 787, 239	2, 103, 602	7, 130, 713	27, 795, 941
1924	2, 224, 555	2, 513, 853	2, 064, 707	6, 803, 115	25, 747, 048
1925	2, 235, 170	2, 819, 690	2, 342, 640	7, 397, 500	26, 162, 361
1926	2, 198, 060	3, 037, 820	2, 135, 720	7, 371, 600	25, 055, 012
1927	2, 263, 030	3, 161, 800	2, 143, 860	7, 568, 690	24, 817, 962

Salt sold or used by producers in the United States, 1926 and 1927, by States

State	1926		1927	
	Short tons	Value	Short tons	Value
California	288, 440	$1, 397, 587	300, 880	$1, 827, 750
Kansas	729, 880	2, 741, 534	794, 780	2, 971, 544
Louisiana	520, 400	2, 457, 875	606, 110	2, 167, 220
Michigan	2, 260, 320	7, 594, 418	2, 271, 460	7, 551, 552
New York	2, 001, 580	6, 564, 829	1, 964, 080	6, 121, 461
Ohio	1, 164, 400	3, 209, 473	1, 203, 170	3, 130, 236
Porto Rico	10, 480	19, 182	15, 150	28, 920
Texas	(1)	(1)	54, 270	399, 171
Utah	77, 350	422, 317	74, 690	334, 732
West Virginia	23, 180	170, 953	22, 600	167, 155
Undistributed [2]	295, 570	476, 844	261, 500	118, 221
	7, 371, 600	25, 055, 012	7, 568, 690	24, 817, 962

[1] Included under "Undistributed."

[2] 1926: Idaho, Nevada, New Mexico, Oklahoma, Texas, and Virginia; 1927: Arizona, Nevada, New Mexico, Oklahoma, and Virginia

Salt imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1918	40, 290	$281, 468	136, 783	$1, 677, 577
1919	59, 514	242, 704	119, 416	1, 396, 625
1920	137, 654	676, 499	139, 272	1, 901, 593
1921	93, 095	531, 031	109, 563	1, 415, 471
1922	113, 922	522, 338	134, 989	1, 429, 172
1923	88, 750	383, 258	125, 529	1, 211, 226
1924	88, 938	324, 092	144, 945	1, 288, 376
1925	85, 788	316, 827	155, 079	1, 219, 935
1926	55, 964	202, 243	158, 908	1, 277, 790
1927	44, 968	167, 675	153, 832	1, 329, 980

SAND AND GRAVEL

Sand and gravel sold or used by producers in the United States, 1918-1927

Year	Glass sand		Molding sand		Building sand	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	2, 172, 887	$4, 209, 728	4, 910, 178	$5, 121, 865	19, 686, 885	$9, 772, 556
1919	1, 827, 409	3, 593, 371	3, 774, 612	4, 153, 990	21, 969, 736	12, 296, 664
1920	2, 165, 926	4, 748, 690	5, 128, 075	7, 504, 759	26, 539, 365	17, 956, 635
1921	1, 280, 359	2, 314, 314	1, 906, 977	2, 451, 966	24, 565, 605	16, 053, 413
1922	1, 768, 549	2, 866, 366	3, 839, 116	4, 478, 405	29, 375, 466	17, 574, 579
1923	2, 034, 958	3, 751, 778	5, 559. 644	6, 730. 417	39, 234, 762	23, 751. 244
1924	2, 169, 899	3, 718, 973	4, 403, 893	4, 995, 268	41. 376, 425	23, 455, 393
1925	2, 334, 921	3, 836, 085	4, 995, 428	5, 400, 618	45, 287, 240	26, 306, 463
1926	2, 274, 218	3, 615, 371	5, 309, 166	5, 630, 799	45, 327, 512	24, 891, 475
1927	2, 171, 693	3, 257, 790	4, 194, 975	4, 458, 508	40, 737, 377	22, 198, 767

Year	Other sand		Gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	6, 349, 870	$5, 259, 620	28, 704, 606	$13, 563, 310	61, 824, 426	$37, 927, 079
1919	8, 397, 979	6, 345, 654	34, 606, 671	19, 561, 877	70, 576, 407	45, 951, 556
1920	9, 942, 776	8, 988, 530	38, 265, 246	26, 462, 991	82, 041, 388	65. 661, 605
1921	10, 542, 013	8, 230, 257	41, 550. 054	27, 434, 295	79, 845, 008	56, 484, 245
1922	14, 711, 792	10, 550, 570	45, 172. 123	29, 147, 744	91, 867, 016	64, 617, 664
1923	20, 535, 907	14, 240, 126	72, 566, 882	42, 430, 089	139. 932, 153	90, 903, 654
1924	27, 621, 793	16, 674, 831	80, 658, 053	48, 168, 650	156, 230, 063	97, 013, 115
1925	34, 564, 633	19, 605, 159	84, 819, 251	52, 393, 798	172. 001, 473	107, 542, 123
1926	39, 203, 383	21, 538, 343	90, 986, 539	55, 662, 713	183, 100, 818	111, 338, 701
1927	46, 484, 294	24, 376, 333	103, 865, 930	61, 238, 388	197, 454, 269	115, 529, 786

Sand and gravel imported into and exported from the United States, 1918-1927

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1918	(1)	$91, 465	(2)	$619, 414
1919	597, 481	126, 586	(2)	382, 070
1920	1, 226, 684	912, 282	(2)	669, 945
1921	906, 905	771, 734	(2)	379, 982
1922	[3] 451, 943	[3] 238, 386	356, 520	400, 199
1923	[4] 477, 762	[4] 259, 820	551, 233	598, 633
1924	[4] 701, 410	[4] 280, 206	314, 140	401, 662
1925	[4] 534, 555	[4] 233, 422	425, 612	496, 070
1926	[4] 947, 579	[4] 341, 911	424, 374	610, 023
1927	[4] 736, 271	[4] 302, 551	421, 243	557, 644

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[1] Quantities not recorded prior to July, 1918. During last 6 months of 1918 the imports were 281,036 tons, valued at $46,910.

[2] Quantities not recorded prior to 1922.

[3] Includes 65,848 tons of gravel, valued at $27,434, and 1,290 tons of glass sand, valued at $1,112, imported after change in tariff Sept. 22. Not separately shown prior to that time.

[4] Includes: 1923, 198,960 tons of gravel, valued at $99,687, and 2,309 tons of glass sand, valued at $3,008; 1924, 448,586 tons, $155,146, and 6,479 tons, $1,961; 1925, 224,609 tons, $89,505, and 4,186 tons, $2,262; 1926, 239,476 tons, $90,226, and 8,817 tons, $9,091; and 1927, 313,809 tons, $104,312, and 10,665 tons, $8,712, respectively.

SAND-LIME BRICK

Sand-lime brick sold in the United States, 1918–1927 [1]

Year	Number of operators	Thousands	Value
1918	42	98,399	$883,929
1919	35	146,947	1,705,163
1920	37	169,761	2,490,283
1921 [2]	26	97,126	1,268,502
1922	(1)	(1)	(1)
1923 [2]	33	213,425	$2,471,536
1924 [2]	37	283,417	3,334,503
1925 [2]	42	315,595	3,780,639
1926 [2]	42	330,586	3,981,492
1927 [2]	47	319,618	3,645,842

[1] Canvass discontinued by U. S. Geological Survey after 1920. No canvass for 1922.

[2] According to Bureau of the Census. Figures represent production.

Imports of sand-lime brick were not reported separately until 1924. The figures for 1924 are 22,426,000 brick, valued at $129,042; for 1925, 148,000 brick, $1,004; for 1926, 3,095,000 brick, $28,748; and for 1927, none.

Exports are not reported separately.

SELENIUM

Most of the selenium produced is a by-product in the electrolytic refining of copper.

Selenium, produced in the United States, sold in 1918–1927

Year	Pounds	Value
1918	103,694	$206,540
1919	60,025	125,966
1920	92,141	175,508
1921	55,978	89,148
1922	123,565	177,542
1923	127,174	$237,196
1924	153,762	286,066
1925	194,007	330,637
1926	252,312	438,132
1927	284,508	491,996

Selenium and selenium salts imported for consumption in the United States, 1918–1927

Year	Pounds	Value
1918		
1919	(1)	$25,866
1920		
1921	1,106	2,099
1922	1,652	2,530
1923	940	$1,653
1924	300	606
1925	5,807	10,582
1926	18,885	34,680
1927	15,286	28,199

[1] Total quantity not recorded.

Exports of selenium are not separately recorded.

SILICA

Quartz sold or used by producers in the United States, 1918–1927

Year	Crude		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	61,008	$121,888	10,732	$137,442	71,740	$259,330
1919	51,774	135,187	11,558	238,384	63,332	373,571
1920	59,423	142,397	8,767	177,953	68,190	320,350
1921	8,570	39,660	2,682	45,297	11,252	84,957
1922	5,085	23,093	5,568	78,254	10,653	101,347
1923	14,159	66,723	6,442	126,907	20,601	193,630
1924	20,570	123,099	3,191	80,078	23,761	203,177
1925	22,312	143,861	3,132	61,515	25,444	205,376
1926	22,230	159,052	5,513	115,281	27,743	274,333
1927	18,504	124,021	3,640	70,019	22,144	194,040

Silica sold or used by producers in the United States for pottery, paints, fillers, polishers, abrasives, and other uses, 1926 and 1927

Material	1926		1927	
	Short tons	Value	Short tons	Value
Quartz (vein quartz, pegmatite, and quartzite)	27,743	$274,333	22,144	$194,040
Sand and sandstone [1]	270,468	1,928,793	275,737	1,897,303
Tripoli (including rottenstone) (ground and otherwise prepared)	31,369	523,609	26,099	117,068
Diatomite	87,126	1,081,564	(2)	(2)
	416,706	3,808,299	(2)	(2)

[1] Includes only finely ground material. Figures probably incomplete.
[2] Bureau of Mines not at liberty to publish figures for diatomite.

Imports of "crude silica" have been as follows: 1927, 12 short tons, valued at $175; 1926, 27 tons, $149; 1925, 22 tons, $486; 1924, 12 tons, $254; and 1923, 34 tons, $550. Similar imports were not recorded prior to September 22, 1922, but from that date to the end of the year 1 ton, valued at $45, was imported. Imports of "silica for use as pigment" in 1927 were 22 short tons, valued at $535; similar imports not separately recorded for earlier years. The Bureau of Foreign and Domestic Commerce records imports of "flint, flints, and flint stones, unground," from several countries. These imports are partly flint pebbles for use in grinding mills and partly material for uses such as are listed above. The figures can not be accurately separated.

"Flint, flints, and flint stones, unground" imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	(1)	$127,808	1923	15,952	$130,974
1919	19,798	250,096	1924	17,473	114,108
1920	26,636	338,630	1925	16,240	105,041
1921	10,084	116,157	1926	15,091	120,078
1922	16,040	145,805	1927	15,191	95,658

[1] Quantities not recorded prior to July, 1918. During last six months of 1918 the imports were 5,224 tons, valued at $55,440.

No exports of silica are reported.

SILVER

[See under Gold and silver]

SLATE

Slate sold by producers in the United States, 1918–1927, by uses

Year	Roofing slate		Mill stock		Slate for other uses[1]	Total value
	Number of squares (100 square feet)	Value	Square feet	Value		
1918	379, 817	$2, 219, 131	7, 204, 000	$1, 853, 603	$768, 386	$4, 841, 120
1919	454, 337	3, 085, 957	7, 466, 000	1, 782, 793	1, 161, 898	6, 030, 648
1920	396, 230	3, 524, 658	9, 910, 000	3, 147, 281	2, 054, 503	8, 726, 442
1921	348, 085	3, 197, 745	8, 970, 000	2, 719, 723	1, 404, 538	7, 322, 006
1922	479, 243	4, 069, 761	9, 276, 800	2, 899, 195	2, 207, 828	9, 176, 784
1923	507, 587	4, 582, 535	11, 109, 480	4, 159, 644	3, 334, 445	12, 076, 624
1924	469, 393	4, 626, 614	10, 009, 180	3, 922, 366	3, 227, 036	11, 776, 016
1925	494, 530	5, 084, 945	11, 077, 860	4, 231, 477	3, 258, 904	12, 575, 326
1926	465, 900	5, 079, 087	10, 278, 130	4, 191, 185	3, 082, 495	12, 352, 767
1927	468, 560	4, 949, 940	9, 287, 680	3, 519, 386	2, 911, 410	11, 380, 736

[1] Chiefly slate granules.

Value of slate sold by producers in the United States, 1923–1927, by States

State	1923	1924	1925	1926	1927
California	(1)	(1)		$2, 976	(1)
Maine	$754, 826	$667, 541	$604, 062	662, 184	$549, 952
Maryland	(1)	117, 137	210, 148	207, 989	205, 812
New York	927, 398	962, 276	851, 715	913, 814	802, 437
Pennsylvania	5, 587, 670	5, 157, 868	5, 885, 179	5, 413, 177	4, 769, 432
Vermont	3, 857, 287	4, 010, 346	3, 963, 025	4, 267, 041	4, 108, 911
Virginia	[2] 321, 010	[2] 336, 627	[2] 377, 082	[2] 331, 651	[2] 398, 612
Undistributed[3]	[4] 628, 433	[4] 524, 221	[4] 684, 115	[4] 553, 935	[4] 545, 580
	12, 076, 624	11, 776, 016	12, 575, 326	12, 352, 767	11, 380, 736

[1] Included under "Undistributed."
[2] Exclusive of value of granules, etc., which is included under "Undistributed."
[3] 1923: California, Georgia, Maryland, New Jersey, and Tennessee; 1924 and 1927: California, Georgia, and Tennessee; 1925: Georgia, Tennessee, and Utah; 1926: Arkansas, Georgia, and Tennessee.
[4] Includes also value of granules, etc., for Virginia.

Slate sold by producers in the United States, 1926 and 1927, by uses

Use	1926		1927	
	Quantity	Value	Quantity	Value
Roofing squares	465, 900	$5, 079, 087	468, 560	$4, 949, 940
Approximate equivalent in short tons	157, 450		176, 540	
Electrical square feet	1, 857, 940	1, 537, 034	1, 417, 060	1, 155, 502
Approximate equivalent in short tons	13, 350		12, 420	
Structural and sanitary square feet	2, 590, 340	988, 521	2, 420, 730	944, 577
Approximate equivalent in short tons	18, 550		18, 760	
Grave vaults and covers square feet	490, 060	130, 882	530, 740	140, 947
Approximate equivalent in short tons	6, 900		4, 920	
Blackboards and bulletin boards square feet	3, 998, 800	1, 356, 405	3, 735, 870	1, 116, 598
Approximate equivalent in short tons	10, 700		10, 490	
Billiard table tops square feet	367, 220	145, 457	402, 700	141, 764
Approximate equivalent in short tons	2, 700		3, 450	
School slates pieces	1, 820, 820	32, 886	1, 459, 100	19, 998
Approximate equivalent in square feet	973, 770		780, 580	
Approximate equivalent in short tons	1, 300		900	
Granules short tons	498, 050	3, 009, 368	459, 760	2, 775, 962
Other short tons (estimated)	9, 000	73, 127	4, 800	135, 448
Total (quantities approximate, in short tons)	718, 000	12, 352, 767	692, 040	11, 380, 736

Value of slate imported for consumption in the United States, 1918–1927

1918	$321	1923	$16, 881
1919	691	1924	32, 095
1920	4, 512	1925	64, 570
1921	2, 923	1926	86, 681
1922	2, 753	1927	78, 909

Value of roofing slate exported from the United States, 1918–1927

1918	$65, 224	1923	$78, 780
1919	55, 164	1924	77, 422
1920	122, 105	1925	54, 130
1921	101, 630	1926	53, 117
1922	97, 811	1927	80, 171

The following figures for exports of slate other than roofing were collected by the Bureau of Mines from shippers of the products named:

Slate other than roofing exported from the United States, 1925–1927, by uses

Use	1925		1926		1927	
	Quantity	Value	Quantity	Value	Quantity	Value
School slates.....cases [1]	11, 050	$111, 271	11, 210	$92, 165	8, 000	$76, 333
Electrical slate.....square feet	[2] 36, 540	[2] 32, 333	51, 490	56, 042	25, 550	26, 916
Blackboards.....do	149, 470	68, 086	125, 730	47, 520	142, 650	50, 120
Billiard tables.....do	32, 180	16, 167	46, 730	37, 903	55, 250	37, 341
Structural.....do	(2)	(2)	39, 870	20, 800	13, 200	9, 100
Slate granules.....short tons	15, 550	100, 300	7, 620	46, 000	11, 300	67, 000
		328, 157		300, 430		266, 810

[1] Cases weigh from 130 to 165 pounds each; average is 135 pounds.
[2] Small quantity of structural slate included with electrical.

SOAPSTONE

[See Talc and soapstone]

SODIUM SALTS (NATURAL)

In addition to common salt, figures for which are given on page A76, the following quantities of other natural sodium salts (including carbonate, bicarbonate, sulphate, trona, and borate) and colemanite have been shipped by the producers.

Sodium salts (other than NaCl), derived from natural sources in the United States, shipped by producers, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	24, 053	$992, 788	1923	59, 440	$1, 775, 940
1919	29, 120	874, 083	1924	76, 420	1, 825, 850
1920	42, 683	1, 513, 179	1925	73, 300	2, 095, 110
1921	25, 000	894, 000	1926	93, 480	2, 326, 750
1922	45, 406	1, 415, 774	1927	145, 770	3, 834, 324

Borates (colemanite and naturally occurring sodium borate) shipped by producers in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	88, 794	$2, 263, 230	1923	136, 650	$3, 994, 790
1919	66, 146	1, 380, 000	1924	116, 110	3, 183, 910
1920	120, 320	2, 173, 000	1925	113, 700	3, 085, 660
1921	50, 000	1, 600, 000	1926	115, 970	3, 128, 110
1922	85, 220	2, 705, 140	1927	109, 080	3, 473, 399

STEEL

[See Iron ore, pig iron, and steel]

STONE

Stone sold or used by producers in the United States, 1918–1927, by varieties

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	3, 827, 400	$14, 466, 423	6, 859, 200	$7, 782, 280	305, 720	$5, 496, 389	53, 868, 200	$49, 453, 006
1919	4, 221, 220	19, 345, 714	7, 410, 770	8, 944, 686	333, 400	8, 042, 297	49, 759, 800	53, 171, 701
1920	4, 760, 000	24, 954, 908	9, 219, 200	12, 260, 148	431, 500	11, 069, 585	59, 290, 000	75, 655, 260
1921	4, 752, 180	20, 592, 217	8, 524, 480	11, 450, 899	315, 400	8, 580, 416	45, 621, 000	57, 749, 594
1922	5, 913, 120	21, 125, 869	10, 032, 900	12, 600, 611	427, 870	10, 534, 671	58, 928, 660	68, 397, 927
1923	7, 300, 130	29, 704, 796	10, 674, 470	13, 539, 648	562, 560	12, 863, 974	76, 701, 360	89, 620, 007
1924	6, 883, 860	28, 772, 161	11, 671, 500	14, 679, 523	516, 000	13, 302, 235	75, 894, 430	89, 868, 956
1925	8, 074, 200	30, 531, 347	11, 842, 110	14, 770, 042	564, 150	13, 882, 457	85, 649, 440	98, 008, 028
1926	9, 330, 390	32, 044, 523	12, 977, 740	15, 950, 302	563, 170	14, 167, 480	91, 887, 900	109, 252, 299
1927	10, 706, 740	35, 287, 206	13, 210, 570	17, 399, 949	600, 060	15, 625, 872	99, 662, 270	112, 439, 824

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	2, 858, 100	$4, 529, 298	844, 740	$973, 034	68, 563, 360	$82, 700, 430
1919	2, 623, 270	5, 283, 842	1, 190, 540	1, 920, 903	65, 539, 000	96, 709, 143
1920	3, 343, 000	7, 310, 290	1, 483, 300	2, 291, 769	78, 527, 000	133, 541, 960
1921	2, 640, 460	6, 425, 339	1, 685, 220	2, 163, 801	63, 538, 740	106, 962, 266
1922	3, 388, 130	7, 521, 044	1, 520, 880	1, 886, 806	80, 211, 560	122, 066, 928
1923	4, 349, 270	9, 174, 706	3, 730, 870	4, 567, 110	103, 318, 660	159, 470, 241
1924	3, 894, 690	10, 142, 099	4, 323, 640	5, 105, 139	103, 184, 120	161, 870, 113
1925	4, 479, 330	10, 920, 016	5, 242, 140	6, 104, 902	115, 851, 370	174, 216, 792
1926	4, 978, 530	11, 149, 029	4, 758, 630	5, 744, 957	124, 496, 360	188, 308, 590
1927	5, 050, 600	10, 923, 035	7, 114, 890	6, 971, 336	136, 345, 130	198, 647, 222

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any of the main groups.

Stone sold or used by producers in the United States, 1926 and 1927, by uses

Use	1926		1927	
	Quantity	Value	Quantity	Value
Building stone.....cubic feet	33, 467, 420	$39, 922, 851	32, 104, 200	$40, 595, 127
Approximate equivalent in short tons	2, 609, 190		2, 485, 120	
Monumental stone.....cubic feet	4, 335, 770	14, 580, 929	4, 325, 390	14, 978, 691
Approximate equivalent in short tons	359, 950		358, 000	
Paving blocks.....number	39, 563, 180	3, 399, 602	38, 705, 500	3, 583, 400
Approximate equivalent in short tons	366, 370		366, 740	
Curbing.....cubic feet	4, 409, 930	4, 303, 280	4, 862, 580	4, 939, 716
Approximate equivalent in short tons	346, 020		378, 230	
Flagging.....cubic feet	902, 424	657, 435	737, 680	573, 736
Approximate equivalent in short tons	66, 330		55, 100	
Rubble.....short tons	539, 670	917, 433	809, 020	998, 108
Riprap.....do	4, 060, 280	4, 652, 717	4, 618, 500	4, 716, 731
Crushed stone.....do	82, 515, 560	87, 872, 014	94, 948, 770	97, 474, 267
Furnace flux (limestone and marble).....do	23, 859, 390	18, 049, 012	21, 666, 070	15, 985, 525
Refractory stone (ganister, mica schist, and dolomite).....short tons	1, 531, 070	1, 925, 832	1, 362, 920	1, 710, 708
Agricultural limestone.....do	1, 850, 620	3, 064, 235	2, 206, 470	3, 360, 704
Manufacturing industries (limestone and marble).....short tons	4, 953, 800	4, 376, 026	5, 352, 130	4, 735, 114
Other.....do	1, 438, 110	4, 587, 224	1, 738, 000	4, 995, 395
Total (quantities approximate, in short tons)	124, 496, 360	188, 308, 590	136, 345, 130	198, 647, 222

Value of stone imported for consumption in the United States, 1918–1927

1918	$268, 577	1923	$2, 641, 337
1919	787, 961	1924	2, 437, 654
1920	1, 795, 575	1925	2, 909, 887
1921	1, 253, 959	1926	3, 523, 578
1922	1, 895, 912	1927	4, 536, 407

Stone imported for consumption in the United States, 1926 and 1927, by kinds

Kind	1926		1927	
	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:				
In blocks, rough, etc. ……cubic feet	863, 219	$1, 783, 767	958, 429	$2, 521, 917
Sawed ……do	1, 676	5, 803	812	4, 665
Slabs or paving tiles ……superficial feet	403, 458	222, 230	925, 792	306, 696
All other manufactures		438, 712		561, 990
Mosaic cubes of marble or onyx:				
Loose		6, 618		9, 144
Attached to paper		410		74
		2, 457, 540		3, 404, 486
Granite:				
Dressed		324, 794		319, 644
Rough ……cubic feet	235, 176	287, 116	188, 395	257, 470
		611, 910		577, 114
Stone (other):				
Dressed		17, 183		27, 830
Rough (monumental or building stone) ……cubic feet	256, 950	181, 040	279, 422	240, 987
Rough (other)		255, 905		285, 990
		454, 128		554, 807
Grand total		3, 523, 578		4, 536, 407

Value of stone exported from the United States, 1918–1927

Year	Marble in blocks, rough or dressed, and other building or monumental stone [1]	Other manufactures of stone [1]	Total	Year	Marble in blocks, rough or dressed, and other building or monumental stone [1]	Other manufactures of stone [1]	Total
1918	$552, 261	$1, 208, 164	$1, 760, 425	1923	$625, 442	$783, 195	$1, 408, 637
1919	770, 392	1, 508, 997	2, 279, 389	1924	499, 602	448, 731	948, 333
1920	774, 442	2, 158, 764	2, 933, 206	1925	507, 391	725, 677	1, 233, 068
1921	576, 905	1, 697, 570	2, 274, 475	1926	687, 115	896, 130	1, 583, 245
1922	681, 658	903, 102	1, 584, 760	1927 [2]	[3] 1, 088, 949	[4] 1, 005, 636	2, 094, 585

[1] Exports classification beginning 1922; prior to 1922 classification read "Stone including marble—unmanufactured and all other."

[2] Figures not separately recorded for 1927 for stone and for cement building blocks and for stone and for cement manufactures.

[3] Composed of "marble in blocks, rough or dressed" $237,233, and "other building or monumental stone (including cement building blocks)," $851,716.

[4] Classification reads "Other manufactures of stone (including other cement manufactures)."

STRONTIUM

No domestic production of strontium ore has been reported since 1918, when 400 short tons, valued at $20,000, was mined.

Strontium chemicals, manufactured in the United States from domestic and imported crude ore, sold in 1918–1924 [1]

Year	Pounds	Value	Year	Pounds	Value
1918	4,148,270	$622,546	1922	2,040,550	$204,022
1919	2,191,409	402,057	1923	2,676,260	303,719
1920	4,713,015	864,251	1924	3,061,532	303,456
1921	847,368	118,655			

[1] Canvass discontinued after 1924.

Imports of strontium ore have been as follows: 1927, 1,356 short tons, valued at $58,711; 1926, 2,200 tons, $58,159; 1925, 1,132 tons, $22,082; 1924, 1,661 tons, $14,487; 1923, 1,679 tons, $12,564. No record of similar imports was kept prior to change in tariff (September 22, 1922), but from that date until the end of the year 1,000 pounds, valued at $40, was imported.

Strontium chemicals and ore imported for consumption in the United States, 1918–1927 [1]

Year	Pounds	Value	Year	Pounds	Value
1918	(2)	$2,459	1923	5,281,818	$131,420
1919	1,225,952	3,380	1924	3,993,226	59,937
1920	1,659,083	15,479	1925	4,826,612	162,533
1921	1,212,758	4,393	1926	5,433,044	115,436
1922 [1]	390,644	22,986	1927	4,233,816	149,383

[1] Celestite (strontium sulphate ore), strontium nitrate, and some other chemicals not included in record prior to Sept. 22, 1922.

[2] Quantities not recorded prior to July, 1918. During last six months of 1918 the imports were 185,920 pounds, valued at $356.

No exports of strontium ore or strontium chemicals have been reported.

SULPHUR

Sulphur produced and shipped in the United States, 1918–1927

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1918	1,353,525	1,266,709	$27,868,000	1923	2,036,097	1,618,841	$26,000,000
1919	1,190,575	678,257	10,252,000	1924	1,220,561	1,537,345	25,000,000
1920	1,255,249	1,517,625	30,000,000	1925	1,409,262	1,858,003	29,000,000
1921	1,879,150	954,344	17,000,000	1926	1,890,027	2,072,657	37,300,000
1922	1,830,942	1,343,624	22,000,000	1927	2,111,618	2,072,109	38,300,000

Sulphur imported into and exported from the United States, 1918–1927

Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value
1918	82	$9,542	131,092	$3,626,638
1919	101	8,633	224,712	6,325,552
1920	136	26,828	477,450	8,994,350
1921	50	5,878	285,762	4,524,768
1922	296	14,743	487,969	7,209,357
1923	465	21,535	474,475	7,216,107
1924	1,005	40,293	484,143	7,894,201
1925	100	4,411	632,250	11,153,781
1926	48	1,052	582,324	11,154,540
1927	3,384	34,487	803,300	16,798,600

TALC AND SOAPSTONE

Talc and soapstone sold by producers in the United States, 1918–1927, by classes

Year	Crude		Sawed and manufactured				Ground		Total	
			Talc		Soapstone					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	17,633	$193,278	1,075	$116,952	12,330	$501,059	177,269	$1,869,730	208,307	$2,681,019
1919	15,625	73,437	921	147,339	16,504	530,163	151,793	1,601,736	184,843	2,352,675
1920	11,008	43,820	1,415	139,335	19,707	709,400	178,505	2,142,894	210,635	3,035,449
1921	2,150	12,911	(1)	(1)	[1] 17,423	[1] 627,826	102,413	1,115,205	121,986	1,755,942
1922	4,981	22,582	654	86,333	22,700	712,144	170,349	2,038,838	198,684	2,859,897
1923	5,706	50,125	682	114,772	22,857	932,098	167,447	1,915,258	196,692	3,012,253
1924	5,710	22,247	846	109,405	25,630	1,288,885	171,635	2,095,019	203,821	3,515,556
1925 [2]	5,684	24,533	895	107,691	(3)	(3)	175,677	1,879,569	182,256	2,011,793
1926 [2]	5,988	26,723	1,528	130,253	(3)	(3)	174,052	1,954,018	181,568	2,110,994
1927 [2]	5,706	25,365	1,494	111,650	(3)	(3)	185,116	2,097,709	192,316	2,234,724

[1] Talc included under "Soapstone."
[2] Figures represent talc only.
[3] Bureau of Mines not at liberty to publish figures for soapstone.

Talc imported for consumption in the United States, 1918–1927

Year	Crude and unground steatite and French chalk		Manufactures (except toilet preparations) wholly or partly finished [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1918	1,434	$9,253	12,735	$251,323	14,169	$260,576
1919	1,641	10,105	12,961	248,899	14,602	259,004
1920	941	7,206	21,739	443,514	22,680	450,720
1921	153	2,279	11,468	239,469	11,621	241,748
1922	248	9,850	18,196	367,528	18,444	377,378
1923	560	20,653	19,405	402,238	19,965	422,891
1924	313	4,847	17,496	337,508	17,809	342,355
1925	121	6,547	20,872	443,985	20,993	450,532
1926	199	16,366	23,642	523,716	23,841	540,082
1927	377	27,326	24,817	523,056	25,194	550,382

[1] Prior to change in tariff, Sept. 22, 1922, the classification was "Talc, steatite, and French chalk—cut, ground, or washed."

No material that might be classed as soapstone is imported.

Exports of "talcum and other toilet powders" have been as follows: 1927, 1,627 short tons, valued at $1,621,068; 1926, 1,645 tons,

$1,726,933; 1925, 1,734 tons, $1,882,196; 1924, 1,614 tons, $1,688,211; 1923, 1,907 tons, $1,671,588; 1922, 1,821 tons, $1,397,542. Exports were not separately classified prior to 1922.

TANTALUM

Columbite, mined in the United States, shipped in 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	4, 500	$2, 250	1923	1, 350	$540
1919	300	90	1924	1, 197	598
1920	4, 000	1, 450	1925	----------	----------
1921	3, 400	1, 150	1926	2, 100	650
1922	600	240	1927	1, 100	378

No imports of tantalum or tantalum ores were recorded for 1918, 1919, 1922, or 1924. For other years in the decade 1918 to 1927 imports have been recorded as follows: 1920, 60 pounds of "ferro-alloys (tantalum)," valued at $54; 1921, 1,229 pounds of "ferro-alloys (tantalum)," $788, and 6,785 pounds of "steel-hardening ores (tantalum)," $1,327. Beginning with 1923 the classification is "Ores of ferro-alloying metals (tantalum)" and the figures are as follows: 1923, 5,600 pounds, $3,031; 1925, 5,022 pounds, $1,347; 1926, 350 pounds, $149; 1927, 15,119 pounds, $20,012.

No separate record of exports is kept.

TELLURIUM

Tellurium is a by-product of the electrolytic refining of copper. Sales amounted to 1,003 pounds, valued at $1,913, in 1927, compared with 1,106 pounds, valued at $2,229, in 1926. Figures for years prior to 1926 are not available for publication.

Imports and exports of tellurium are not reported.

THORIUM MINERALS

In 1925, 2,000 pounds of monazite, estimated to contain 6 per cent of thoria, was shipped from Florida. The value of this monazite is estimated by the Bureau of Mines as $120. No monazite is known to have been produced in the United States from 1918 to 1924 or in 1926 and 1927.

Monazite sand and thorium nitrate imported for consumption in the United States, 1918–1927

Year	Monazite sand		Thorium nitrate	
	Pounds	Value	Pounds	Value
1918	2, 994, 515	$204, 661	----------	----------
1919	632, 568	48, 768	3, 307	$5, 250
1920	1, 814, 183	141, 528	35, 640	43, 221
1921	50	40	44, 554	89, 672
1922	3, 466, 844	210, 187	43, 254	42, 096
1923	253, 730	11, 334	24, 027	29, 789
1924	546, 560	18, 320	14, 150	13, 721
1925	----------	----------	21, 519	22, 661
1926	669, 760	23, 816	21, 403	27, 955
1927	1, 193, 920	41, 029	10, 492	13, 514

Exports of thorium nitrate in 1922 amounted to 1,103 pounds, valued at $3,149. Data for other years are not separately shown.

TIN

Tin mined in the United States (including Alaska), 1918–1927

[Metallic tin obtainable from concentrates produced in tin mining]

Year	Short tons	Value[1]	Year	Short tons	Value[1]
1918	69	$118, 500	1923	2	$1, 623
1919	56	73, 400	1924	7	7, 028
1920	22	22, 000	1925	14	15, 980
1921	4	2, 400	1926	8	10, 400
1922	[2] 1	912	1927	27	34, 600

[1] Value calculated at average price per pound of Straits tin in New York, as published by American Metal Market.
[2] 2,800 pounds.

Smelter production of metallic tin in the United States, 1918–1927, in short tons

1918	10, 284	1922	9, 108
1919	12, 236	1923	7, 466
1920	17, 652	1924	486
1921	11, 542	1925–1927	(1)

[1] None reported.

Secondary tin recovered as metal and in alloys and chemical compounds in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	23, 837	$41, 381, 000	1923	30, 210	$25, 316, 000
1919	24, 033	29, 868, 200	1924	31, 300	31, 062, 100
1920	23, 500	22, 705, 700	1925	30, 950	35, 165, 400
1921	16, 900	9, 668, 500	1926	33, 400	42, 511, 500
1922	19, 510	12, 443, 500	1927	36, 900	46, 302, 100

Metallic tin imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	71, 254	$93, 144, 218	1923	77, 206	$61, 092, 354
1919	44, 849	50, 890, 019	1924	72, 866	68, 953, 193
1920	62, 795	73, 440, 872	1925	85, 843	95, 121, 111
1921	27, 101	16, 645, 719	1926	86, 418	104, 793, 396
1922	67, 416	40, 797, 986	1927	79, 679	100, 865, 205

Tin ore (concentrate) imported into the United States, 1918–1927

[General imports]

Year	Short tons	Value	Year	Short tons	Value
1918	18, 394	$11, 444, 401	1923	3, 015	$2, 169, 055
1919	19, 196	11, 871, 948	1924	[1] 174	71, 094
1920	34, 148	18, 795, 162	1925	[1] 214	98, 489
1921	15, 340	5, 672, 861	1926	[1] 339	187, 396
1922	13, 804	5, 504, 434	1927	[1] 137	79, 089

[1] Recorded as tin content.

Exports of tin ore are insignificant.

Metallic tin (pigs, bars, etc.) of domestic manufacture exported from the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	20	$31,952	1923	840	$646,250
1919	306	415,921	1924	469	453,482
1920	706	770,375	1925	404	445,782
1921	1,154	748,077	1926	756	708,151
1922	901	574,792	1927	1,131	888,563

TITANIUM MINERALS

Titanium minerals produced in the United States, 1918–1927

Year	Rutile concentrates			Ilmenite concentrates		
	Short tons	Percentage of TiO_2	Value	Short tons	Percentage of TiO_2	Value
1918	261	95	$39,150	1,644	53–55	$18,600
1919[1]	102	94–96	20,400	106	48–50	2,120
1920	277	94–96	(2)	268	50	(2)
1921						
1922	310	95	(2)	5,181	52–54	(2)
1923	270	95	(2)	6,270	52	(2)
1924				4,769	52	[3] 76,300
1925	46	95	[3] 11,000	5,566	52	[3] 89,000
1926[4]	30	95	[3] 7,500	4,813	52	[3] 77,000
1927	(2)	(2)	(2)	3,500	50	44,000

[1] Virginia production only; information regarding Florida not available for publication.
[2] Bureau of Mines not at liberty to publish figures.
[3] Estimate by Bureau of Mines.
[4] Figures for Florida only. Bureau of Mines not at liberty to publish figures for Virginia.

No imports of titanium or "titanium steel-hardening" ores have been recorded since 1918, although ilmenite is known to have been imported from Senegal, West Africa; from Brazil; from Travancore, India; and possibly from other places. Such imports are not separately classified by the Bureau of Foreign and Domestic Commerce. Imports of "titanium steel-hardening" ores during last six months of 1918 were 1,606 pounds, valued at $221. No separate record of similar imports was kept prior to July, 1918. Imports of "titanium potassium oxalate and all compounds and mixtures containing titanium" amounted to 107,389 pounds, valued at $16,145, in 1927; to 81,604 pounds, $12,232, in 1926; to 81,721 pounds, $12,368, in 1925; to 24,134 pounds, $3,639, in 1924; to 39,763 pounds, $6,423, in 1923; and to 82,544 pounds, $20,596, from September 22 to December 31, 1922. Similar imports were not separately classified prior to change in tariff. For imports of ferrotitanium see under Ferro-alloys.

No separate record of exports of titanium, "titanium steel-hardening" ores, or ferrotitanium is kept.

TRIPOLI

[See Abrasive materials]

TUNGSTEN

Concentrated tungsten ores (carrying 60 per cent of tungsten trioxide), produced in the United States, sold in 1918–1927, and average value per unit

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per unit			Total	Average per unit
1918	5,061	$7,049,300	$23.24	1923	241	$144,600	$10.00
1919	327	353,900	18.02	1924	565	287,000	8.47
1920	216	101,800	7.86	1925	1,191	755,500	10.57
1921	------	------	------	1926	1,382	920,400	11.10
1922	------	------	------	1927	1,164	724,000	10.37

Tungsten-bearing ore [1] imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	11,750	$11,552,218	1923	------	------
1919	9,408	6,261,190	1924	------	------
1920	1,949	779,593	1925	427	$206,326
1921	1,614	276,757	1926	1,267	566,996
1922	1,651	279,190	1927	1,085	540,409

[1] Prior to Sept. 22, 1922, imports recorded as ore; beginning with change in tariff, recorded as tungsten content of ore.

For imports of tungsten and ferrotungsten see under Ferro-alloys.

For 1922 the following domestic exports are recorded: "Tungsten ores and concentrates (tungsten content)," 717 pounds, valued at $594. No tungsten ores of domestic production are recorded as exported in 1918 to 1921, and, although exports for later years are not separately shown, it is practically certain that no domestic ores have been exported.

For exports of tungsten and ferrotungsten see under Ferro-alloys.

URANIUM AND VANADIUM ORES

Uranium and vanadium ores shipped from mines in the United States, 1918–1927

Year	Ores		Radium isolated (grams)	Estimated content of ores		
	Short tons	Approximate value as ore		Radium (grams)	Uranium (short tons)	Vanadium (short tons)
1918	18,860	$957,000	21.7	27.1	89.5	276
1919	14,509	1,630,900	28.648	29.0	95.7	284.2
1920	35,076	2,401,000	32.539	43.4	143.5	526.7
1921	8,540	876,000	35.693	33.0	109.0	201.5
1922	929	166,016	24.189	7.0	23.2	25.9
1923	2,025	150,000	12.212	5.5	18.2	63.3
1924	(1)	(1)	(1)	(1)	(1)	(1)
1925	13,070	331,000	(1)	4.3	14.3	216
1926	21,624	329,000	(1)	.4	1.2	330.7
1927	(1)	(1)	------	(1)	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures.

Value of uranium salts and oxide, including radium salts, imported for consumption in the United States, 1918–1927

1918	$274	1923	$500, 456
1919	12, 960	1924	418, 307
1920	3	1925	480, 889
1921	8, 552	1926	596, 433
1922	28, 685	1927	452, 633

No imports of "uranium-radium ore (steel-hardening)" were recorded for 1922 to 1927 and for 1919. Imports in 1920 and 1921 were 396 pounds, $1,110, and 250 pounds, $446, respectively. Similar imports were not recorded separately prior to July 1, 1918, but from that date to the end of the year 157 pounds, valued at $4,840, was imported.

Vanadium ore (steel-hardening) imported for consumption in the United States 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918—July to December [1]	886	$5, 333	1923	2, 089	$229, 210
1919	3, 013	67, 846	1924	7, 058	722, 731
1920	10, 337	1, 080, 935	1925	2, 368	339, 468
1921	5, 154	543, 061	1926	8, 368	914, 114
1922	306	86, 776	1927	6, 943	561, 051

[1] Not separately classified prior to July, 1918.

For imports of ferrovanadium see under Ferro-alloys.

No separate record is kept of vanadium exports. For exports of ferrovanadium see under Ferro-alloys.

ZINC [1]

Primary zinc produced in the United States from domestic ores, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	492, 405	$89, 618, 000	1923	508, 335	$69, 134, 000
1919	452, 272	66, 032, 000	1924	515, 831	67, 058, 000
1920	450, 045	72, 907, 000	1925	555, 631	84, 456, 000
1921	198, 232	19, 823, 000	1926	611, 991	91, 799, 000
1922	353, 274	40, 273, 000	1927	576. 960	73, 851, 000

[1] For prices of zinc, see statement on p. A11.

Primary zinc produced in the United States, 1923–1927, by sources of ore, in short tons

Source	1923	1924	1925	1926	1927
United States	508. 335	515, 831	555, 631	611, 991	576, 960
Foreign:					
Canada		1, 396	7, 997		
Mexico	2, 099	112	9, 318	6, 431	15, 556
Total foreign	2, 099	1, 508	17, 315	6, 431	15, 556
Grand total	510, 434	517, 339	572, 946	618, 422	592, 516

Primary zinc produced in the United States, 1923–1927, by method of reduction and by location of reduction plant, in short tons

	1923	1924	1925	1926	1927
Distilled:					
Arkansas	29, 870	28, 447	27, 145	32, 712	26, 317
Illinois	93, 239	93, 370	109, 672	110, 381	102, 768
Kansas	32, 006	28, 640	25, 765	33, 671	33, 144
Oklahoma	119, 744	118, 487	138, 906	136, 560	120, 801
Pennsylvania	82, 003	83, 016	99, 899	100. 538	106, 099
Other States	82, 484	87, 886	92, 555	92, 964	90, 758
Electrolytic: Montana	71, 088	77, 493	79, 004	111, 596	112, 629
	510, 434	517, 339	572, 946	618, 422	592, 516

Secondary zinc recovered as metal in the United States, 1918–1927, in short tons

Year	Redistilled	Remelted	Recovered in alloys, excluding old brass remelted	Recovered in remelted brass (estimate)
1918	9, 918	17, 190	11, 082	82, 400
1919	19, 748	20, 162	6, 062	62, 400
1920	21, 371	21, 479	7, 650	65, 000
1921	17, 573	16, 260	5, 840	38, 600
1922	32, 988	36, 326	10, 250	60, 000
1923	39, 434	25, 776	8, 630	65, 000
1924	35, 486	23, 400	10, 500	63, 000
1925	39, 181	22, 249	13, 300	53, 300
1926	40, 799	23, 771	13, 430	63, 000
1927	42, 784	22, 016	12, 400	63, 200

Zinc imported for consumption in the United States, 1918–1927

Year	Blocks or pigs		Sheets		Old		Zinc dust		Manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1918	11	$2, 897	(1)	$29	24	$2, 056	16	$3, 552	$331	$8, 865
1919	32	2, 284	1	249	37	2, 216	52	5, 753	1, 258	11, 760
1920	(1)	17	4	614	14	1, 065	17	6, 207	1. 746	9, 649
1921	6, 598	559, 870	6, 688	496, 445	6	341	42	1, 121	8, 290	1, 066, 067
1922	40	3, 327	416	59, 037	46	2, 403	79	5, 614	9, 517	79, 898
1923	1	375	(1)	41	20	1, 624	4	891	16, 331	19, 262
1924	11	1, 973	(1)	88	14	1, 493	59	9, 241	20, 089	32, 884
1925	(1)	303	(1)	55	24	2, 495	116	20, 936	18, 979	42, 768
1926	(1)	195	(1)	46	21	1, 315	2	451	44, 574	46, 581
1927	39	5, 089	1	271	19	1, 443	(1)	114	91, 519	98, 436

[1] Less than 1 ton.

Zinc content of zinc ores [1] imported for consumption in the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	8, 501	$291, 449	1923	[2] 2, 007	$273, 105
1919	2, 978	119, 540	1924	[2] 332	32, 850
1920	6, 971	198, 156	1925	[2] 57	6, 205
1921	9, 387	252, 951	1926	[2] 55	4, 181
1922	[2] 1, 895	18, 903	1927	[2] 154	10, 401

[1] Classification as follows: 1918–1922, "Ore, zinc-bearing, including calamine (zinc content)"; 1923–1927, "Zinc ores (zinc content)."

[2] Content of ore imported duty free and containing less than 10 per cent of zinc is separately recorded after Sept. 21, 1922, but is excluded from figures as zinc content is not recovered.

Zinc exported from the United States, 1918–1927

Year	Domestic				Foreign slabs	
	Slabs		Sheets			
	Short tons	Value	Short tons	Value	Short tons	Value
1918	66, 369	$12, 469, 622	13, 875	$4, 566, 756	20, 069	$3, 565, 127
1919	109, 746	17, 524, 153	19, 762	5, 212, 002	12, 256	1, 943, 507
1920	74, 046	12, 495, 144	11, 852	2, 832, 993	28, 132	4, 331, 636
1921	1, 753	204, 984	1, 816	425, 618	1, 256	100, 677
1922	26, 815	2, 994, 625	3, 217	574, 491	3, 471	429, 122
1923	42, 131	5, 961, 525	3, 732	764, 369	7, 080	941, 257
1924	[1] 72, 583	[1] 9, 538, 459	3, 658	784, 728	(1)	(1)
1925	[1] 76, 351	[1] 11, 654, 441	4, 196	926, 841	(1)	(1)
1926	[1] 42, 920	[1] 6, 360, 671	4, 641	1, 086, 967	(1)	(1)
1927	[1] 45, 695	[1] 6, 035, 382	3, 922	869, 425	(1)	(1)

[1] Foreign included with domestic. Not separately recorded after 1923.

ZINC RESIDUUM

[See Manganiferous zinc residuum]

ZIRCONIUM MINERALS

The Bureau of Mines is advised that shipments of zircon from Pablo Beach, Fla., from 1922 to 1927 were as shown in the table that follows; no shipments were reported for 1918 to 1921. Brazil is the world's main producer of zirconium ores. The zirconium minerals produced in Brazil and exported consist of the silicate, zircon, and the oxide, baddeleyite.

Zircon, produced in the United States, shipped in 1922–1927 [1]

Year	Short tons	Value (estimate by Bureau of Mines)	Year	Short tons	Value (estimate by Bureau of Mines)
1922	10	$1, 000	1925	624	$62, 400
1923	153	15, 300	1926	1, 292	129, 200
1924	281	28, 100	1927	3, 646	364, 600

[1] No shipments reported for 1918 to 1921.

Zirconium ores (steel-hardening) imported for consumption in the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918—July to December [1]	3, 216, 659	$77, 250	1923		
1919	11, 023	332	1924	616, 220	$4, 878
1920			1925		
1921	131, 016	3, 003	1926		
1922	67, 037	4, 072	1927	4, 488	182

[1] Not separately classified prior to July, 1918.

STATE TABLES

Mineral production of Alabama in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	22,000	$101,000	32,650	$128,700
Bauxite long tons			4,060	24,690
Cement barrels	[1] 6,693,900	[1] 10,825,421	[1] 7,313,494	[1] 10,615,428
Clay products		[2] 5,181,571		[2] [3] 4,823,670
Clay, raw short tons	110,007	[4] 171,424	127,397	[4] 176,418
Coal do	21,000,962	48,036,000	19,765,866	44,524,000
Coke do	[5] 4,779,986	[4] [5] 16,823,492	4,364,354	[4] 13,500,234
Ferro-alloys long tons	([4] [6])	([4] [6])	([4] [6])	([4] [6])
Graphite, crystalline pounds	([6])	([6])	3,474,000	146,730
Iron ore long tons	6,871,412	13,846,656	6,508,419	12,973,597
Iron, pig do	2,875,534	[4] 58,119,260	2,705,240	[4] 50,193,057
Lime short tons	220,732	1,721,558	206,010	1,566,287
Manganese ore long tons	896	([6])	([6])	([6])
Manganiferous ore do	1,018	6,421	([6])	([6])
Mica, sheet pounds			([6])	([6])
Mineral waters gallons sold	([7])	([7])	([7])	([7])
Sand and gravel short tons	2,417,161	1,245,210	2,085,696	1,292,233
Sand-lime brick thousands			([2] [6])	([2] [6])
Stone short tons	1,296,440	2,048,193	1,238,750	1,797,375
Miscellaneous [8]		2,951,871		2,975,147
Total value, eliminating duplications		83,709,894		78,640,669

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[1] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] Exclusive of beehive coke, value for which is included under "Miscellaneous," but not in total value for State.
[6] Value included under "Miscellaneous."
[7] No canvass.
[8] Includes minerals indicated by "1," "3," "5," and "6" above.

Mineral production of Alaska in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Coal short tons	87,300	$459,000	104,300	$548,000
Copper pounds	67,778,000	9,488,920	55,343,000	7,249,933
Gold troy ounces	324,451	6,707,000	286,719	5,927,000
Lead short tons	778	124,480	1,008	127,008
Mercury flasks	([1])	([1])	([1])	([1])
Natural gas M cubic feet	([1])	([1])	([1])	([1])
Natural gasoline gallons	33,000	4,000	19,000	2,000
Ores (crude), etc.:				
Copper short tons	670,000	([2])	645,000	([2])
Dry and siliceous (gold and silver) do	3,924,925	([2])	4,352,000	([2])
Lead do	427	([2])		
Petroleum barrels	7,600	9,600	([1])	([1])
Platinum and allied metals troy ounces	3,331	233,211	115	6,940
Silver do	690,000	430,560	627,800	355,962
Stone short tons	([1])	([1])	([1])	([1])
Tin (metallic equivalent) do	8	10,400	27	34,400
Miscellaneous [3]		139,719		151,197
Total value, eliminating duplications		17,606,890		14,402,440

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[1] Value included under "Miscellaneous."
[2] Not valued as ore; value of recoverable metal content included under the metals.
[3] Includes minerals indicated by "1" above.

Mineral production of Arizona in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asbestos, short tons	(1)	(1)	(1)	(1)
Barite, do	(1)	(1)		
Clay products		[2] $197,037		[2] $345,391
Clay, raw, short tons	(1 3)	(1 3)	(1 3)	(1 3)
Coal, do	624	1,000	4,583	6,000
Copper, pounds	723,296,051	101,261,447	682,190,547	89,366,962
Feldspar (crude), long tons	(1)	(1)	(1)	(1)
Fuller's earth, short tons			(1)	(1)
Gems and precious stones		(4)		(4)
Gold, troy ounces	234,011	4,837,436	200,495	4,144,591
Gypsum, short tons	(1)	(1)	(1)	(1)
Lead, do	11,629	1,860,662	9,933	1,251,556
Lime, do	42,757	421,549	41,859	390,074
Manganese ore, long tons	2,684	(1)	3,905	41,880
Manganiferous ore, do	46	(1)	179	754
Mercury, flasks	(1)	(1)	(1)	(1)
Molybdenum, pounds			(1)	(1)
Ores (crude), etc.:				
Copper, short tons	22,031,292	(5)	21,677,976	(5)
Copper-lead and copper-lead-zinc, do	25,020	(5)	11,930	(5)
Dry and siliceous (gold and silver), do	139,949	(5)	151,701	(5)
Lead, do	157,854	(5)	137,195	(5)
Lead-zinc, do	22,037	(5)	11,752	(5)
Zinc, do	6,533	(5)	1,320	(5)
Pumice, do	15	150	20	200
Salt, do			(1)	(1)
Sand and gravel, do	392,351	113,906	92,956	46,363
Silver, troy ounces	7,381,027	4,605,761	6,847,680	3,882,635
Sodium sulphate from natural sources, short tons	(1)	(1)	(1)	(1)
Stone, do	685,970	397,632	311,930	297,206
Sulphuric acid (60° Baumé) [6], do	29,367	(1 3)	72,153	(1 3)
Tungsten ore (60 per cent concentrates), do	25	15,000	(1)	(1)
Uranium and vanadium ores, do	(1)	(1)		
Zinc, do	6,473	970,982	1,134	145,213
Miscellaneous [7]		571,287		1,113,086
Total value, eliminating duplications		115,047,987		100,558,556

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] From copper smelting.
[7] Includes minerals indicated by "1" above.

Mineral production of Arkansas in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Bauxite, long tons	371,570	$2,298,550	303,830	$1,892,860
Clay products		[1 2] 1,544,771		[1 2] 1,285,720
Clay, raw, short tons	442	[3] 2,106	335	[3] 1,966
Coal, do	1,459,017	5,497,000	1,548,834	5,393,000
Gems and precious stones		(4)		(4)
Iron ore sold for magnets, long tons	10	(5)	5	(5)
Lead, short tons	18	2,880	23	2,898
Lime, do	31,346	275,935	35,375	307,335
Manganese ore, long tons	2,450	64,010	2,605	64,202
Manganiferous ore, do	8,195	47,428	7,444	48,678
Mineral waters, gallons sold	(4)	(4)	(4)	(4)
Natural gas, M cubic feet	43,566,000	5,817,000	30,450,000	4,281,000
Natural gasoline, gallons	30,385,000	2,867,000	37,498,000	2,281,000
Oilstones, short tons	158	106,317	(5)	(5)
Ores (lead and zinc), do	(6)	(6)	(6)	(6)
Petroleum, barrels	58,332,000	64,600,000	40,005,000	42,400,000
Sand and gravel, short tons	1,529,484	847,579	1,461,693	832,520
Slate		(5)		
Stone, short tons	388,200	435,108	418,770	486,792
Zinc, do	87	13,050	128	16,384
Miscellaneous [7]		69,044		156,711
Total value, eliminating duplications		84,485,672		59,449,100

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Exclusive of pottery, value for which is included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Value included under "Miscellaneous."
[6] Figures not available.
[7] Includes minerals indicated by "2" and "5" above.

Mineral production of California in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asphalt (native)__short tons__	3, 330	$19, 310	(1)	(1)
Barite__do__	(1)	(1)	13, 919	$71, 708
Borates__do__	84, 490	2, 796, 700	(1)	(1)
Briquets, fuel__do__	(1, 2)	(1, 2)	(1, 2)	(1, 2)
Bromine__pounds__	(3)	(3)	(1)	(1)
Calcium chloride__short tons__	(1)	(1)	(1)	(1)
Cement__barrels__	13, 660, 078	25, 299, 245	14, 433, 153	26, 623, 396
Chromite__long tons__	91	979	201	5, 063
Clay products__		[4] 20, 569, 492		[4] 20, 904, 490
Clay, raw__short tons__	297, 329	[2] 804, 978	290, 309	[2] 778, 420
Coal__do__	(1)	(1)	(1)	(1)
Copper__pounds__	33, 466, 299	4, 685, 282	27, 133, 008	3, 554, 424
Diatomite__short tons__	(1)	(1)	(1)	(1)
Feldspar (crude)__long tons__	6, 271	49, 300	5, 260	43, 329
Fuller's earth__short tons__	(1)	(1)		
Gems and precious stones__		(5)		(5)
Gold__troy ounces__	576, 798	11, 923, 481	564, 586	11, 671, 018
Graphite, crystalline__pounds__			(1)	(1)
Gypsum__short tons__	(1)	(1)	(1)	(1)
Ilmenite__do__			(1)	(1)
Iron ore__long tons__	282	(1)		
Lead__short tons__	4, 047	647, 481	1, 359	171, 235
Lime__do__	67, 421	800, 089	64, 934	708, 010
Lithium minerals__do__	(1)	(1)	(1)	(1)
Magnesite__do__	53, 940	604, 130	43, 750	507, 500
Magnesium salts (natural)__pounds__	(6)	(6)	(1)	(1)
Manganese ore__long tons__	393	8, 750		
Marl, calcareous__short tons__	8, 346	27, 924	(1)	(1)
Mercury__flasks__	5, 726	526, 237	5, 748	670, 217
Mineral waters__gallons sold__	(5)	(5)	(5)	(5)
Natural gas__M cubic feet__	204, 915, 000	36, 425, 000	212, 364, 000	50, 946, 000
Natural gasoline__gallons__	389, 366, 000	[7] 45, 945, 000	498, 020, 000	52, 436, 000
Ores (crude), etc.:				
Copper__short tons__	930, 464	(8)	854, 084	(8)
Copper-lead__do__	383	(8)	193	(8)
Dry and siliceous (gold and silver)__do__	717, 326	(8)	619, 122	(8)
Lead__do__	30, 445	(8)	14, 066	(8)
Lead-zinc__do__	25, 162	(8)	14, 679	(8)
Zinc__do__	57, 079	(8)	24, 266	(8)
Peat__do__	6, 065	56, 192	(5)	(5)
Pebbles for grinding__do__	102	612	288	1, 856
Petroleum__barrels__	224, 673, 000	345, 547, 000	231, 196, 000	260, 735, 000
Platinum and allied metals__troy ounces__	95	11, 402	132	12, 646
Potassium salts__short tons__	(1)	(1)	(1)	(1)
Pumice__do__	320	9, 600	2, 434	22, 286
Pyrites__long tons__	(1)	(1)	(1)	(1)
Salt__short tons__	288, 440	1, 397, 587	300, 880	1, 827, 750
Sand and gravel__do__	13, 164, 670	8, 820, 047	14, 260, 128	8, 045, 257
Sand-lime brick__thousands__	(1, 4)	(1, 4)	(1, 4)	(1, 4)
Shale oil__gallons__	(9)	(10)	(9)	(10)
Silica (quartz)__short tons__	8, 902	103, 016	6, 755	61, 802
Silver__troy ounces__	2, 022, 460	1, 262, 015	1, 620, 242	918, 677
Slate__		2, 976		(1)
Sodium salts (carbonate, bicarbonate, and trona) from natural sources__short tons__	56, 680	1, 153, 860	67, 240	1, 253, 352
Stone__do__	9, 248, 240	10, 546, 571	9, 764, 740	9, 963, 054
Talc and soapstone__do__	15, 419	233, 292	15, 760	238, 755
Tungsten ore (60 per cent concentrates)__do__	490	358, 600	(1)	(1)
Zinc__do__	10, 217	1, 532, 542	4, 031	516, 008
Miscellaneous [11]__		3, 009, 335		7, 588, 545
Total value, eliminating duplications__		524, 282, 257		439, 497, 072

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[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures not available.
[4] Figures obtained through cooperation with Bureau of the Census.
[5] No canvass.
[6] Value included under "Miscellaneous." Output of magnesium chloride in 1926 was 12,277,000 pounds, valued at $105,480; Bureau of Mines not at liberty to publish figures for magnesium sulphate.
[7] Value estimated by the Bureau of Mines.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Bureau of Mines not at liberty to publish figures.
[10] No data available.
[11] Includes minerals indicated by "1" and "6" above.

Mineral production of Colorado in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement..........barrels..	(1)	(1)	(1)	(1)
Clay products..........	....	[2] $3, 381, 776	....	[2] [3] $2, 998, 486
Clay, raw..........short tons..	199, 867	[4] 254, 523	218, 255	[4] 319, 994
Coal..........do....	10, 637, 225	29, 529, 000	9, 724, 075	27, 044, 000
Coke..........do....	790, 118	(1 4)	788, 586	(1 4)
Copper..........pounds..	3, 403. 850	476, 539	5, 670, 581	742, 846
Feldspar (crude)..........long tons..	(1)	(1)	(1)	(1)
Fluorspar..........short tons..	10, 440	(1)	6, 432	(1)
Gems and precious stones..........	....	(5)	....	(5)
Gold..........troy ounces..	342, 400	7, 078, 033	255, 377	5, 279, 118
Gypsum..........short tons..	(1)	(1)	(1)	(1)
Iron ore..........long tons..	35, 535	(1)	32, 206	(1)
Iron, pig..........do....	(1 4)	(1 4)	(1 4)	(1 4)
Lead..........short tons..	34, 494	5, 519, 024	33, 386	4, 206, 671
Lime..........do....	12, 470	127, 975	11, 900	125. 875
Manganese ore..........long tons..	....	....	(1)	(1)
Manganiferous ore:				
For fluxing..........do....	6, 656	9, 208	1, 029	(1)
For other purposes..........do....	2, 925	(1)	26, 828	126, 938
Mica, scrap..........short tons..	(1)	(1)	(1)	(1)
Micaceous minerals (vermiculite)..........do....	....	....	(1)	(1)
Mineral paints, zinc and lead pigments..do....	13, 751	[4] 1, 713, 362	(1 4)	(1 4)
Mineral waters..........gallons sold..	(5)	(5)	(5)	(5)
Molybdenum..........pounds..	(1)	(1)	(1)	(1)
Natural gas..........M cubic feet..	553, 800	130, 000	1, 725, 400	290, 000
Natural gasoline..........gallons..	276, 000	17, 000	912, 000	64, 000
Ores (crude), etc.:				
Copper..........short tons..	2, 126	(6)	467	(6)
Copper-lead..........do....	97	(6)	410	(6)
Dry and siliceous (gold and silver)...do....	1, 240, 195	(6)	1, 035, 305	(6)
Lead..........do....	93, 531	(6)	61, 275	(6)
Lead-zinc..........do....	495, 507	(6)	508, 679	(6)
Zinc..........do....	8, 284	(6)	392	(6)
Petroleum..........barrels..	2, 768, 000	5, 100, 000	2, 831, 000	3, 400, 000
Sand and gravel..........short tons..	764, 523	590, 695	622, 204	465, 818
Shale oil..........gallons..	3, 360	(7)	(8)	(7)
Silver..........troy ounces..	4, 704, 122	2, 935, 372	3, 784, 605	2, 145, 871
Stone..........short tons..	911, 450	1, 107, 867	[9] 883, 140	[9] 975, 953
Tungsten ore (60 per cent concentrates)..do....	232	148, 200	332	209, 007
Uranium and vanadium ores..........do....	20, 511	292, 000	(1)	(1)
Zinc..........do....	32, 500	4, 875, 000	35, 865	4, 590, 656
Miscellaneous [10]..........	....	15, 439, 688	....	19, 176, 739
Total value, eliminating duplications....	....	65, 597, 487	....	58, 855, 263

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[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] No data available.
[8] Bureau of Mines not at liberty to publish figures.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1," "3," and "9" above.

Mineral production of Connecticut in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		[1] [2] $3,291,298		[1] [2] $2,652,640
Clay, raw ... short tons	794	[3] 9,491	621	[3] 6,225
Feldspar (crude) ... long tons	11,436	87,844	6,123	43,319
Lime ... short tons	61,742	695,495	53,304	608,550
Mica:				
Scrap ... do			(4)	(4)
Sheet ... pounds	(4)	(4)	(4)	(4)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Sand and gravel ... short tons	1,059,556	451,069	667,983	485,169
Sand-lime brick ... thousands	(1 4)	(1 4)	(1 4)	(1 4)
Silica (quartz) ... short tons	246	1,678		
Stone ... do	[6] 2,069,920	[6] 2,680,849	2,295,360	3,202,040
Miscellaneous [7]		487,108		307,382
Total value, eliminating duplications		7,695,341		7,299,100

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Exclusive of pottery, value for which is included under "Miscellaneous."
[3] Value not included in total value for State.
[4] Value included under "Miscellaneous."
[5] No canvass.
[6] Exclusive of limestone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "2," "4," and "6" above.

Mineral production of Delaware in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		[1] $156,897		[1] $293,089
Clay, raw ... short tons	7,237	[2] 89,442	6,561	[2] 82,656
Marl, greensand ... do	(3)	(3)	(3)	(3)
Potassium salts ... do	(3 4)	(3 4)	(3 4)	(3 4)
Sand and gravel ... do	83,325	61,186	61,177	42,338
Stone ... do	99,150	157,637	(3)	(3)
Miscellaneous [5]		1,825		159,435
Total value, eliminating duplications		375,945		493,377

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] Value included under "Miscellaneous."
[4] Value not included in total value for State, as value of raw product (greensand marl) is included.
[5] Includes minerals indicated by "3" above.

Mineral production of the District of Columbia in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		[1] $208,683		(1 2)
Clay, raw ... short tons			(1 3)	(1 2)
Sand and gravel ... do	561,688	583,080	990,927	$1,048,381
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Stone ... short tons	5,890	20,526	6,630	21,350
Miscellaneous		175,000		305,228
Total value, eliminating duplications		987,289		1,374,719

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.

Mineral production of Florida in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement barrels			(1)	(1)
Clay products		[2] $465, 960		[2, 3] $462, 190
Clay, raw short tons	56, 344	[4] 772, 124	47, 319	[4] 646, 415
Fuller's earth do	(1)	(1)	(1)	(1)
Lime do	9, 424	100, 241	5, 317	59, 491
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Peat short tons	(1)	(1)	(5)	(5)
Phosphate rock long tons	2, 708, 207	8, 683, 508	2, 637, 420	8, 646, 162
Sand and gravel short tons	1, 841, 009	1, 483, 757	1, 588, 907	930, 504
Sand-lime brick thousands	[2] 19, 743	[2] 223, 896	[2] 7, 102	[2] 74, 898
Stone short tons	6, 785, 430	7, 411, 506	7, 437, 580	6, 138, 767
Titanium minerals:				
Ilmenite do	4, 813	[6] 77, 000	(1)	(1)
Rutile do	30	[6] 7, 500	(1)	(1)
Zircon do	1, 292	[6] 129, 200	3, 646	[6] 364, 600
Miscellaneous [7]		1, 117, 954		1, 419, 349
Total value, eliminating duplications		19, 700, 522		18, 095, 961

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Value estimated by the Bureau of Mines.
[7] Includes minerals indicated by "1" and "3" above.

Mineral production of Georgia in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asbestos short tons	(1)	(1)	(1)	(1)
Barite do	77, 654	$532, 706	94, 039	$580, 300
Bauxite long tons	19, 680	108, 650	13, 050	71, 230
Cement barrels	(1)	(1)	(1)	(1)
Clay products		[2, 3] 5, 957, 486		[2] 4, 879, 736
Clay, raw short tons	205, 801	[4] 1, 398, 061	222, 938	[4] 1, 537, 378
Coal do	59, 869	173, 000	76, 712	233, 000
Coke do	3, 059	[4] 23, 034	(1 4)	(1 4)
Fuller's earth do	(1)	(1)	(1)	(1)
Gold troy ounces	149	3, 074	50	1, 042
Iron ore long tons	51, 642	149, 198	50, 312	147, 068
Lime short tons	18, 526	141, 257	13, 533	99, 604
Manganese ore long tons	3, 251	29, 890	489	(1)
Manganiferous ore do	24, 961	148, 199	20, 210	136, 094
Mica:				
Scrap short tons	(1)	(1)	(1)	(1)
Sheet pounds	(1)	(1)	(1)	(1)
Micaceous minerals (chlorite schist) short tons			(1)	(1)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Ore (dry and siliceous) (gold and silver) short tons	4, 140	(6)		
Sand and gravel do	839, 459	343, 322	683, 366	295, 505
Sand-lime brick thousands			(1 2)	(1 2)
Silver troy ounces	9	5	7	4
Slate		(1)		(1)
Stone short tons	820, 570	5, 470, 561	[7] 849, 290	[7] 6, 146, 613
Talc do	4, 220	89, 000	3, 110	42, 370
Miscellaneous [8]		4, 333, 619		4, 139, 502
Total value, eliminating duplications		17, 479, 967		16, 758, 390

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of sandstone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1," "3," and "7" above.

Mineral production of Idaho in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Antimony ore ..... short tons	99	(1)		
Clay products		(1 2)		[2] $205,993
Clay, raw ..... short tons	569	[3] $5,787	477	[3] 5,748
Coal ..... do	(1)	(1)	(1)	(1)
Copper ..... pounds	1,337,442	187,242	2,173,163	284,684
Diatomite ..... short tons			(1)	(1)
Gems and precious stones		(4)		(4)
Gold ..... troy ounces	13,669	282,569	15,316	316,603
Lead ..... short tons	136,490	21,838,417	151,019	19,028,421
Lime ..... do	(1)	(1)	(1)	(1)
Manganese ore ..... long tons	830	(1)	3,181	50,900
Manganiferous ore ..... do	351	(1)		
Mercury ..... flasks	6	551		
Ores (crude), etc.:				
Copper ..... short tons	28,258	(5)	27,742	(5)
Copper-lead ..... do	22,037	(5)	40,125	(5)
Dry and siliceous (gold and silver) ..... do	5,862	(5)	5,268	(5)
Lead ..... do	1,084,345	(5)	1,308,987	(5)
Lead-zinc ..... do	793,641	(5)	636,203	(5)
Phosphate rock ..... long tons	33,113	133,020	45,260	259,405
Salt ..... short tons	(1)	(1)		
Sand and gravel ..... do	225,345	58,985	198,091	81,238
Silver ..... troy ounces	7,556,444	4,715,221	8,901,409	5,047,099
Stone ..... short tons	[6] 179,320	[6] 295,209	286,410	400,160
Zinc ..... do	26,307	3,946,102	26,778	3,427,606
Miscellaneous [7]		295,505		81,820
Total value, eliminating duplications		31,752,821		29,183,929

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of limestone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of Illinois in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Barite ..... short tons	(1)	(1)		
Cement ..... barrels	[2] 6,977,598	[2] $11,388,800	[2] 7,061,240	[2] $11,312,783
Clay products		[3] 37,030,004		[3] 34,452,605
Clay, raw ..... short tons	205,926	[4] 410,476	198,306	[4] 381,228
Coal ..... do	69,366,923	148,604,000	46,848,224	101,356,000
Coke ..... do	3,336,962	[4] 25,050,474	3,013,940	[4] 21,076,519
Ferro-alloys ..... long tons	(1 4)	(1 4)		
Fluorspar ..... short tons	53,734	1,012,879	46,006	863,909
Fuller's earth ..... do	(1)	(1)	(1)	(1)
Iron, pig ..... long tons	3,626,330	[4] 73,460,392	3,466,203	[4] 66,442,068
Lead ..... short tons	655	104,800	277	34,902
Lime ..... do	103,180	1,013,740	115,803	1,084,093
Marl, calcareous ..... do	(1)	(1)	100	50
Mineral paints, zinc and lead pigments ..... do	16,046	[4] 2,206,036	16,014	[4] 2,027,696
Mineral waters ..... gallons sold	(5)	(5)	(5)	(5)
Natural gas ..... M cubic feet	3,808,000	863,000	3,741,000	764,000
Natural gasoline ..... gallons	9,987,000	967,000	8,853,000	532,000
Ores (crude), etc.:				
Lead-zinc ..... short tons	195,100	(6)	49,000	(6)
Zinc ..... do	50,000	(6)	39,200	(6)
Peat ..... do	(1)	(1)	(5)	(5)
Petroleum ..... barrels	7,760,000	17,200,000	6,994,000	11,700,000
Sand and gravel ..... short tons	17,777,169	8,714,350	19,328,703	9,166,934
Sand and sandstone (finely ground) ..... do	84,748	529,350	(1)	(1)
Sand-lime brick ..... thousands			(1 3)	(1 3)
Silver ..... troy ounces	2,990	1,866	1,518	861
Stone ..... short tons	[7] 9,145,180	[7] 8,479,277	9,699,530	8,127,506
Sulphuric acid (60° Baumé)[8] ..... do	247,203	[4] 2,346,000	241,025	[4] 2,352,000
Tripoli ..... do	11,948	192,483	(1)	(1)
Zinc ..... do	2,577	386,550	521	66,688
Miscellaneous [9]		859,728		931,448
Total value, eliminating duplications		237,241,600		180,393,779

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of sandstone, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1," "2," and "7" above.

Mineral production of Indiana in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement.....barrels..	(1)	(1)	(1)	(1)
Clay products.....	.....	[2] $18, 747, 835	.....	[2] $17, 855, 971
Clay, raw.....short tons..	206, 233	[3] 237, 497	163, 593	[3] 206, 361
Coal.....do....	23, 186, 006	45, 889, 000	17, 935, 758	36, 381, 000
Coke.....do....	5, 990, 344	[3] 44, 143, 059	5, 549, 762	[3] 37, 152, 981
Iron, pig.....long tons..	3, 670, 478	[3] 69, 292, 329	3, 447, 764	[3] 62, 097, 518
Lime.....short tons..	126, 005	970, 624	116, 171	830, 527
Mineral paints, zinc and lead pigments..do....	(1 3)	(1 3)	(1 3)	(1 3)
Mineral waters.....gallons sold..	(4)	(4)	(4)	(4)
Natural gas.....M cubic feet..	901, 000	379, 000	1, 124, 000	509, 000
Peat.....short tons..	(1)	(1)	(4)	(4)
Petroleum.....barrels..	808, 000	1, 770, 000	852, 000	1, 390, 000
Rubbing stones, scythestones, and whetstones.....short tons..	280	40, 867	285	37, 461
Sand and gravel.....do....	12, 009, 308	5, 194, 448	11, 870, 658	5, 552, 804
Sand-lime brick.....thousands..	(1 2)	(1 2)	(1 2)	(1 2)
Stone.....short tons..	4, 699, 230	22, 797, 189	5, 813, 000	22, 634, 359
Sulphuric acid [5].....do....	(1 3)	(1 3)	(1 3)	(1 3)
Miscellaneous [6].....	.....	24, 867, 257	.....	24, 808, 283
Total value, eliminating duplications....	.....	118, 692, 304	.....	107, 578, 234

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] From zinc smelting.
[6] Includes minerals indicated by "1" above.

Mineral production of Iowa in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement.....barrels..	4, 788, 639	$8, 167, 341	5, 661, 234	$9, 124, 405
Clay products.....	.....	[1 2] 4, 459, 724	.....	[1 2] 5, 158, 104
Clay, raw.....short tons..	1, 717	[3] 13, 707	2, 463	[3] 16, 516
Coal.....do....	4, 625, 487	14, 214, 000	2, 949, 622	9, 304, 000
Ferro-alloys.....long tons..	(3 4)	(3 4)	(3 4)	(3 4)
Gypsum.....short tons..	802, 910	6, 588, 203	792, 159	6, 713, 497
Lime.....do....	(4)	(4)	(4)	(4)
Mineral waters.....gallons sold..	(5)	(5)	(5)	(5)
Sand and gravel.....short tons..	2, 694, 751	1, 569, 006	3, 981, 143	1, 839. 176
Stone.....do....	938, 520	897, 262	1, 274, 380	1, 231, 546
Miscellaneous [6].....	.....	1, 000, 596	.....	1, 235, 257
Total value, eliminating duplications.....	.....	35, 971, 787	.....	33, 426, 375

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Exclusive of pottery, value for which is included under "Miscellaneous."
[3] Value not included in total value for State.
[4] Value included under "Miscellaneous."
[5] No canvass
[6] Includes minerals indicated by "2" and "4" above.

Mineral production of Kansas in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement ... barrels	[1] 6,150,694	[1] $9,757,699	[1] 6,141,937	[1] $9,939,412
Chats ... short tons	238,000	47,600	150,000	17,500
Clay products		[2] 3,969,040		[2] [3] 3,805,509
Coal ... short tons	4,416,480	12,535,000	3,443,762	9,648,000
Gypsum ... do	195,440	1,220,720	175,351	975,649
Lead ... do	28,463	4,554,080	27,497	3,464,622
Mineral paints, zinc and lead pigments ... do	(4 5)	(4 5)	(4 5)	(4 5)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet	38,095,000	12,547,700	42,646,000	12,833,000
Natural gasoline ... gallons	25,369,000	2,105,000	36,095,000	1,746,000
Ores (crude), etc.:				
Lead ... short tons	5,000	(7)	4,700	(7)
Lead-zinc ... do	4,224,900	(7)	3,480,400	(7)
Zinc ... do	487,600	(7)	1,020,700	(7)
Petroleum ... barrels	41,498,000	93,800,000	41,069,000	58,300,000
Pumice ... short tons	48,869	152,190	45,439	152,748
Salt ... do	729,880	2,741,534	794,780	2,971,544
Sand and gravel ... do	2,489,343	1,491,492	2,254,648	1,456,130
Stone ... do	[8] 850,560	[8] 1,057,276	801,450	922,532
Zinc ... do	126,307	18,946,050	109,427	14,006,656
Miscellaneous [9]		1,701,479		1,802,024
Total value, eliminating duplications		165,060,612		120,368,526

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value included under "Miscellaneous."
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of sandstone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1," "3," "4," and "8" above.

Mineral production of Kentucky in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asphalt (native) ... short tons	320,430	$2,530,480	344,220	$3,156,700
Barite ... do	(1)	(1)		
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products		[2] 7,676,858		[2] [3] 7,257,664
Clay, raw ... short tons	128,585	[4] 706,776	119,829	[4] 662,149
Coal ... do	62,924,462	109,740,000	69,123,998	119,249,000
Coke ... do	(1 4)	(1 4)	(1 4)	(1 4)
Fluorspar ... do	62,494	1,167,129	57,495	1,040,338
Iron, pig ... long tons	148,053	(1 4)	184,851	(1 4)
Lead ... short tons	58	9,280	139	17,514
Lime ... do	8,550	55,663	6,862	47,620
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	10,410,000	3,378,000	10,206,000	3,277,000
Natural gasoline ... gallons	7,689,000	914,000	7,480,000	547,000
Ores (lead and zinc) ... short tons	(6)	(6)	(6)	(6)
Petroleum ... barrels	6,274,000	15,250,000	6,719,000	11,220,000
Phosphate rock ... long tons	(1)	(1)		
Sand and gravel ... short tons	3,214,487	2,234,586	3,002,311	1,718,055
Stone ... do	1,907,960	2,168,183	2,603,770	2,863,779
Whetstones ... do	(1)	(1)		
Zinc ... do	1,838	275,700	860	110,080
Miscellaneous [7]		8,183,913		8,407,996
Total value, eliminating duplications		146,768,273		152,614,177

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Figures not available.
[7] Includes minerals indicated by "1" and "3" above.

Mineral production of Louisiana in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement..........barrels..	....	....	(1)	(1)
Clay products..........	....	[2] $682,307	....	[2] [3] $446,156
Lime..........short tons..	(1)	(1)	....	....
Mineral waters..........gallons sold..	(4)	(4)	(4)	(4)
Natural gas..........M cubic feet..	157,423,000	8,768,000	186,961,000	12,158,000
Natural gasoline..........gallons..	43,557,000	3,692,000	44,844,000	2,442,000
Petroleum..........barrels..	23,201,000	38,200,000	22,818,000	29,740,000
Salt..........short tons..	520,400	2,457,875	606,110	2,167,220
Sand and gravel..........do....	2,689,840	1,784,315	2,723,112	1,910,064
Sand-lime brick..........thousands..	(1 2)	(1 2)	(1 2)	(1 2)
Stone..........short tons..	122,870	207,883	115,450	169,643
Sulphur..........long tons..	(1)	(1)	(1)	(1)
Miscellaneous [5]..........	....	6,411,163	....	2,233,838
Total value, eliminating duplications.....	....	62,203,543	....	51,266,921

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] No canvass.
[5] Includes minerals indicated by "1" and "3" above.

Mineral production of Maine in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products..........	....	(1 2)	....	[1] $680,739
Clay, raw..........short tons..	(2 3)	(2 3)	266	[3] 3,392
Feldspar (crude)..........long tons..	33,897	$306,695	34,328	299,386
Gems and precious stones..........	....	(4)	....	(4)
Lime..........short tons..	128,120	1,615,776	116,566	1,230,356
Lithium minerals..........do....	....	....	(2)	(2)
Marl, calcareous..........do....	(2)	(2)	500	4,250
Mica:				
Scrap..........do....	....	....	(2)	(2)
Sheet..........pounds..	....	....	(2)	(2)
Mineral waters..........gallons sold..	(4)	(4)	(4)	(4)
Peat..........short tons..	....	....	(4)	(4)
Sand and gravel..........do....	491,260	220,931	584,395	251,448
Silica (quartz)..........do....	328	1,050	(2)	(2)
Slate..........	....	662,184	....	549,952
Stone..........short tons..	311,830	2,360,593	355,800	2,447,644
Miscellaneous [5]..........	....	622,294	....	11,920
Total value, eliminating duplications.....	....	5,785,619	....	5,475,695

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "2" above.

Mineral production of Maryland in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asbestos ......short tons..	(1)	(1)	(1)	(1)
Briquets, fuel ......do....	(1 2)	(1 2)	(1 2)	(1 2)
Cement ......barrels..	(1)	(1)	(1)	(1)
Chromite ......long tons..	50	$1, 100	....	....
Clay products	....	[3] 6, 073, 247	....	[3] [4] $2, 503, 935
Clay, raw ......short tons..	61, 326	[2] 130, 918	38, 551	[2] 102, 690
Coal ......do....	3, 078, 353	6, 800, 000	2, 814, 842	5, 817, 000
Coke ......do....	1, 120, 610	(1 2)	1, 077, 309	(1 2)
Diatomite ......do....	220	2, 400	80	800
Feldspar (crude) ......long tons..	(1)	(1)	2, 001	11, 612
Ferro-alloys ......do....	(1 2)	(1 2)	(1 2)	(1 2)
Iron, pig ......do....	791, 637	(1 2)	845, 564	(1 2)
Lime ......short tons..	63, 639	524, 242	55, 405	439, 457
Marl, calcareous ......do....	(1)	(1)	2, 452	9, 499
Mineral waters ......gallons sold..	(5)	(5)	(5)	(5)
Potassium salts ......short tons..	(1)	(1)	(1)	(1)
Sand and gravel ......do....	3, 467, 211	3, 115, 454	2, 914, 448	2, 185, 248
Silica (quartz) ......do....	4, 681	47, 507	4, 409	37, 717
Slate	....	207, 989	....	205, 812
Stone ......short tons..	[6] 1, 432, 290	[6] 2, 177, 102	1, 214, 110	2, 039, 243
Talc ......do....	2, 857	41, 780	(1)	(1)
Miscellaneous [7]	....	27, 374, 915	....	28, 342, 638
Total value, eliminating duplications......	....	24, 066, 996	....	20, 469, 294

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Exclusive of marble, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1," "4," and "6" above.

Mineral production of Massachusetts in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Briquets, fuel ......short tons..	....	....	(1 2)	(1 2)
Clay products	....	[3] $3, 971, 586	....	[3] [4] $2, 398, 474
Clay, raw ......short tons..	1, 950	[2] 28, 973	1, 626	[2] 23, 240
Coke ......do....	573, 748	(1 2)	744, 091	[2] 6, 008, 556
Fuller's earth ......do....	(1)	(1)	(1)	(1)
Iron, pig ......long tons..	23, 130	(1 2)	129, 039	(1 2)
Lime ......short tons..	202, 065	2, 653, 746	189, 343	2, 325, 031
Manganiferous ore ......long tons..	(1)	(1)	(1)	(1)
Mineral waters ......gallons sold..	(5)	(5)	(5)	(5)
Sand and gravel ......short tons..	2, 969, 172	3, 276, 787	2, 646, 335	2, 495, 696
Sand-lime brick ......thousands..	(1 3)	(1 3)	(1 3)	(1 3)
Silica (quartz) ......short tons..	(1)	(1)	(1)	(1)
Stone ......do....	[6] 2, 089, 340	[6] 6, 216, 793	[6] 2, 629, 890	[6] 7, 291, 969
Miscellaneous [7]	....	6, 284, 324	....	4, 313, 124
Total value, eliminating duplications......	....	16, 786, 577	....	16, 295, 373

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1," "4," and "6" above.

Mineral production of Michigan in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Bromine..........pounds..	(1)	(1)	(1)	(1)
Calcium chloride..........short tons..	(1)	(1)	(1)	(1)
Cement..........barrels..	11, 959, 447	$19, 499, 788	13, 708, 259	$20, 858, 202
Clay products..........	....	[2] 7, 362, 007	....	[2] 6, 772, 283
Clay, raw..........short tons..	4, 287	[3] 9, 349	3, 539	[3] 6, 620
Coal..........do....	686, 707	2, 829, 000	756, 763	3, 262, 000
Coke..........do....	1, 826, 638	[3] 12, 713, 083	1, 920, 394	[3] 12, 227, 241
Copper..........pounds..	175, 381, 565	24, 553, 419	177, 537, 775	23, 257, 449
Ferro-alloys..........long tons..	....	....	2, 415	(1 3)
Gems and precious stones..........	....	(4)	....	(4)
Graphite, amorphous..........short tons..	(1)	(1)	(1)	(1)
Grindstones..........do....	(1)	(1)	(1)	(1)
Gypsum..........do....	659, 685	5, 021, 465	668, 617	4, 216, 524
Iron ore:				
Sold to furnaces..........long tons..	16, 699, 984	43, 932, 982	14, 532, 831	37, 135, 364
Sold for paint..........do....	2, 942	(1)	2, 045	(1)
Iron, pig..........do....	638, 282	[3] 13, 180, 113	626, 532	[3] 12, 527, 993
Lime..........short tons..	107, 671	995, 123	101, 172	931, 597
Magnesium..........pounds..	181, 300	[3] 219, 370	219, 950	[3] 163. 300
Magnesium chloride (natural)..........do....	(1)	(1)	(1)	(1)
Magnesium sulphate (natural)..........do....	(1)	(1)	(1)	(1)
Manganiferous ore..........long tons..	107, 202	(1)	74, 739	(1)
Mineral waters..........gallons sold..	(4)	(4)	(4)	(4)
Natural gas..........M cubic feet..	400	200	600	300
Ore (copper)..........short tons..	7, 641, 682	(5)	8, 046, 334	(5)
Peat..........do....	(1)	(1)	(4)	(4)
Petroleum..........barrels..	94, 000	253, 000	439, 000	832, 000
Salt..........short tons..	2, 260, 320	7, 594, 418	2, 271, 460	7, 551, 552
Sand and gravel..........do....	14, 398, 338	7, 265, 161	15, 419, 499	7, 800, 541
Sand-lime brick..........thousands..	[2] 108, 434	[2] 1, 341, 284	[2] 112, 181	[2] 1, 402. 647
Silver..........troy ounces..	105, 242	65, 671	97, 193	55, 109
Stone..........short tons..	[6] 10, 885, 730	[6] 6, 715. 429	[6] 11, 442, 780	[6] 6, 560, 946
Miscellaneous [7]..........	....	3, 431, 662	....	3, 481, 205
Total value, eliminating duplications.....	....	130, 860, 609	....	124, 029, 572

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of Minnesota in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement..........barrels..	(1)	(1)	(1)	(1)
Clay products..........	....	[2 3] $1, 852, 566	....	[2 3] $1, 675, 662
Clay, raw..........short tons..	11, 850	[4] 26, 719	17, 287	[4] 40, 640
Coke..........do....	619, 905	[4] 6, 014, 738	632, 628	[4] 6, 212, 501
Flint lining for tube mills..........do....	(1)	(1)	(1)	(1)
Gems and precious stones..........	....	(5)	....	(5)
Iron ore..........long tons..	40, 961, 361	103, 715, 621	35, 563, 177	87, 935, 099
Iron, pig..........do....	292, 658	(1 4)	287, 813	(1 4)
Lime..........short tons..	28, 522	296, 068	(1)	(1)
Manganiferous ore..........long tons..	958, 217	(1)	940, 875	2, 192, 051
Mineral waters..........gallons sold..	(5)	(5)	(5)	(5)
Pebbles for grinding..........short tons..	(1)	(1)	(1)	(1)
Sand and gravel..........do....	3, 271, 884	1, 913, 708	3, 515, 554	2, 171, 625
Sand-lime brick..........thousands..	[2] 12, 389	[2] 124, 265	[2] 16, 186	[2] 171, 753
Stone..........short tons..	682, 800	3, 746, 392	802, 340	4, 259, 766
Miscellaneous [6]..........	....	12, 744, 187	....	9, 881, 765
Total value, eliminating duplications....	....	118, 361, 306	....	102, 972, 753

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
Includes minerals indicated by "1" and "3" above.

Mineral production of Mississippi in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		[1, 2] $1,006,661		[1, 2] $1,146,472
Clay, raw ... short tons	4,873	[3] 34,958	2,805	[3] 20,308
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet			(5)	(5)
Sand and gravel ... short tons	1,952,783	871,638	3,122,401	1,372,089
Stone ... do	(5)	(5)	(5)	(5)
Miscellaneous [6]		4,687		35,072
Total value, eliminating duplications		1,882,986		2,553,633

[1] Figures obtained through cooperation with Bureau of the Census.

[2] Exclusive of pottery, value for which is included under "Miscellaneous."

[3] Value not included in total value for State.

[4] No canvass.

[5] Value included under "Miscellaneous."

[6] Includes minerals indicated by "[2]" and "[5]" above.

Mineral production of Missouri in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Barite ... short tons	118,919	$946,595	111,456	$797,465
Briquets, fuel ... do	(1 2)	(1 2)	(1 2)	(1 2)
Cement ... barrels	7,639,966	12,917,342	6,929,229	11,117,047
Chats ... short tons	1,679,800	419,940	2,107,620	526,933
Clay products		[3] 17,618,931		[3] 16,392,171
Clay, raw ... short tons	460,746	[2] 1,571,026	416,490	[2] 1,693,792
Coal ... do	3,008,495	8,951,000	3,064,343	8,698,000
Coke ... do	(1 2)	(1 2)	(1 2)	(1 2)
Copper ... pounds	1,077,000	150,780	451,000	59,081
Iron ore ... long tons	124,371	532,536	78,605	317,070
Lead ... short tons	207,012	33,121,920	198,760	25,643,760
Lime ... do	263,467	2,218,943	267,776	2,189,420
Mineral paints, zinc and lead pigments ... do	(1 2)	(1 2)	(1 2)	(1 2)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	1,000	700	300	200
Ores (crude), etc.:				
Copper ... short tons	27	(5)		
Lead ... do	6,324,500	(5)	6,337,500	(5)
Lead-zinc ... do	412,000	(5)	231,700	(5)
Zinc ... do	550,600	(5)	254,800	(5)
Sand and gravel ... do	4,611,952	2,980,242	4,829,473	2,875,520
Sand and sandstone (finely ground) ... do	(1)	(1)	(1)	(1)
Sand-lime brick ... thousands			(1 3)	(1 3)
Silver ... troy ounces	90,000	56,160	233,931	132,638
Stone ... short tons	3,093,000	6,012,013	[6] 3,064,600	[6] 5,170,879
Tripoli ... do	(1)	(1)	(1)	(1)
Zinc ... do	26,018	3,902,700	18,737	2,398,336
Miscellaneous [7]		4,129,106		4,017,412
Total value, eliminating duplications		90,003,537		75,899,115

[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Figures obtained through cooperation with Bureau of the Census.

[4] No canvass.

[5] Not valued as ore; value of recoverable metal content included under the metals.

[6] Exclusive of unclassified stone, value for which is included under "Miscellaneous."

[7] Includes minerals indicated by "[1]" and "[6]" above.

Mineral production of Montana in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Arsenious oxide ... short tons	6, 190	$301, 396	7, 329	$397, 404
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products		[2] 273, 121		[2] 299, 622
Clay, raw ... short tons	14, 986	[3] 17, 245	13, 207	[3] 24, 231
Coal ... do	2, 797, 760	6, 883, 000	3, 143, 638	7, 403, 000
Copper ... pounds	255, 372, 862	35, 752, 201	223, 492, 639	29, 277, 536
Ferro-alloys ... long tons	(1 3)	(1 3)	(1 3)	(1 3)
Gems and precious stones		(4)		(4)
Gold ... troy ounces	60, 504	1, 250, 731	53, 541	1, 106, 796
Graphite, crystalline ... pounds			(1)	(1)
Gypsum ... short tons	(1)	(1)	(1)	(1)
Iron ore ... long tons	724	1, 810	2, 837	10, 156
Lead ... short tons	21, 153	3, 384, 495	17, 949	2, 261, 594
Lime ... do	8, 099	64, 916	11, 607	90, 512
Manganese ore ... long tons	23, 617	(1)	26, 506	836, 675
Manganiferous ore ... do			10, 332	(1)
Micaceous minerals (vermiculite) ... short tons	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	2, 283, 000	450, 000	4, 253, 100	716, 400
Ores (crude), etc.:				
Copper ... short tons	3, 179, 051	(5)	2, 958, 445	(5)
Copper-lead ... do	224, 322	(5)	263, 868	(5)
Dry and siliceous (gold and silver) ... do	93, 571	(5)	111, 976	(5)
Lead ... do	132, 039	(5)	57, 182	(5)
Lead-zinc ... do	820, 081	(5)	498, 732	(5)
Zinc ... do	20, 991	(5)	332, 404	(5)
Petroleum ... barrels	7, 727, 000	10, 170, 000	5, 058, 000	7, 090, 000
Sand and gravel ... short tons	935, 443	313, 268	2, 187, 934	910, 513
Silver ... troy ounces	12, 769, 092	7, 967, 913	11, 200, 077	6, 350, 444
Stone ... short tons	[6] 294, 120	[6] 257, 919	219, 510	191, 021
Sulphuric acid (60° Baumé) [7] ... do	37, 559	(1 3)	34, 317	(1 3)
Tungsten ore (60 per cent concentrates) ... do			(1)	(1)
Zinc ... do	73, 701	11, 055, 113	80, 231	10, 269, 555
Miscellaneous [8]		1, 847, 348		1, 242, 280
Total value, eliminating duplications		79, 766, 380		68, 264, 687

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of basalt, value for which is included under "Miscellaneous."
[7] From copper smelting.
[8] Includes minerals indicated by "1" and "6" above.

Mineral production of Nebraska in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products		[2 3] $1, 112, 923		[2 3] $819, 494
Clay, raw ... short tons	35, 363	[4] 37, 260	4, 1[illegible]	[4] 4, 759
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Pumice ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	2, 134, 452	1, 124, 764	2, 420, 364	1, 370, 60
Stone ... do	105, 740	185, 057	170, 500	332, 222
Miscellaneous [6]		899, 716		1, 019, 471
Total value, eliminating duplications		3, 322, 460		3, 541, 792

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by "1" and "3" above.

Mineral production of Nevada in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Barite ... short tons	(1)	(1)	884	$3, 969
Borates ... do	(1)	(1)	(1)	(1)
Clay products		(1 2)		(1 2)
Clay, raw ... short tons	12, 018	[3] $78, 827	5, 910	[3] 36, 458
Coal ... do			(1)	(1)
Copper ... pounds	101, 827, 937	14, 255, 911	120, 259, 276	15, 753, 965
Diatomite ... short tons	230	4, 350	344	5, 924
Fuller's earth ... do	(1)	(1)	32, 903	348, 070
Gems and precious stones		(4)		(4)
Gold ... troy ounces	175, 382	3, 625, 461	150, 346	3, 107, 931
Graphite, amorphous ... short tons	(1)	(1)	(1)	(1)
Gypsum ... do	350, 972	1, 527, 235	327, 365	1, 484, 171
Lead ... do	11, 184	1, 789, 437	7, 892	994, 444
Lime ... do	23, 162	239, 469	(1)	(1)
Manganese ore ... long tons	1, 607	(1)	1, 357	16, 976
Manganiferous ore:				
For fluxing ... do	11, 051	(1)	2, 161	(1)
For other purposes ... do	12, 205	58, 941	3, 310	(1)
Mercury ... flasks	197	18, 105	425	49, 555
Mica, sheet ... pounds			(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Copper ... short tons	4, 888, 681	(5)	4, 885, 052	(5)
Copper-lead ... do	10, 151	(5)	25, 304	(5)
Dry and siliceous (gold and silver) ... do	806, 518	(5)	515, 825	(5)
Lead ... do	111, 265	(5)	75, 924	(5)
Lead-zinc ... do	67, 641	(5)	27, 582	(5)
Zinc ... do	312	(5)	1, 465	(5)
Salt ... do	(1)	(1)	(1)	(1)
Sand and gravel ... do	515, 267	205, 583	462, 574	187, 150
Silica (quartz) ... do	2, 292	12, 125	1, 030	6, 180
Silver ... troy ounces	6, 518, 983	4, 067, 845	5, 397, 179	3, 060, 200
Sodium sulphate from natural sources ... short tons	180	1, 750	(1)	(1)
Stone ... do	[6] 59, 030	[6] 89, 072	700, 710	570, 508
Sulphur ... long tons			(1)	(1)
Tungsten ore (60 per cent concentrates) ... short tons	545	356, 700	372	(1)
Zinc ... do	5, 409	811, 337	3, 172	406, 049
Miscellaneous [7]		549, 911		758, 203
Total value, eliminating duplications		27, 613, 232		26, 753, 295

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of marble, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of New Hampshire in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		[1] $881, 997		[1] $811, 626
Diatomite ... short tons	2	130	7	455
Feldspar (crude) ... long tons	33, 271	287, 596	27, 449	223, 077
Garnet, abrasive ... short tons	(2)	(2)	(2)	(2)
Mica:				
Scrap ... do	1, 738	38, 213	1, 284	22, 909
Sheet ... pounds	1, 371, 890	235, 890	720, 219	78, 849
Millstones		3, 563		1, 025
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Sand and gravel ... short tons	708, 098	731, 639	863, 618	653, 214
Scythestones ... do	(2)	(2)	(2)	(2)
Silica (quartz) ... do	277	1, 053	(2)	(2)
Stone ... do	148, 250	1, 908, 284	[4] 178, 300	[4] 1, 584, 262
Miscellaneous [5]		56, 280		71, 688
Total value, eliminating duplications		4, 144, 645		3, 447, 105

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "2" and "4" above.

Mineral production of New Jersey in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	(1 2)	(1 2)	(1 2)	(1 2)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products	-------------	[3] $47,512,514	-------------	[3] $43,099,769
Clay, raw ... short tons	342,586	[2] 1,463,288	312,410	[2] 1,270,572
Coke ... do	913,250	(1 2)	906,321	(1 2)
Ferro-alloys ... long tons	(1 2)	(1 2)	(1 2)	(1 2)
Iron ore:				
Sold to furnaces ... do	212,152	925,403	202,720	860,393
Sold for paint ... do	-------------	-------------	(1)	(1)
Iron, pig ... do	(1 2)	(1 2)	-------------	-------------
Lime ... short tons	(1)	(1)	(1)	(1)
Manganiferous residuum [4] ... long tons	179,926	(1)	(1)	(1)
Marl, greensand ... short tons	12,606	174,365	11,259	163,048
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Ore (zinc) ... short tons	573,300	(6)	629,108	(6)
Peat ... do	29,326	129,664	(5)	(5)
Sand and gravel ... do	4,455,412	3,576,320	4,627,159	3,602,289
Sand and sandstone (finely ground) ... do	(1)	(1)	(1)	(1)
Sand-lime brick ... thousands	[3] 49,854	[3] 585,703	(1 3)	(1 3)
Stone ... short tons	2,315,450	3,589,119	2,760,880	4,334,526
Talc ... do	(1)	(1)	(1)	(1)
Zinc ... do	80,629	(1)	95,695	(1)
Miscellaneous [7]	-------------	28,839,630	-------------	28,624,304
Total value, eliminating duplications	-------------	77,065,713	-------------	73,090,810

[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Figures obtained through cooperation with Bureau of the Census.

[4] Ore mined in New Jersey; smelted in Pennsylvania.

[5] No canvass.

[6] Not valued as ore; value of recoverable metal content included under the metal.

[7] Includes minerals indicated by "1" above.

Mineral production of New Mexico in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products	-------------	(1 2)	-------------	[1] $161,666
Clay, raw ... short tons	2,118	[3] $10,517	8,196	[3] 17,414
Coal ... do	2,817,923	8,916,000	2,935,539	9,179,000
Coke ... do	(2 3)	(2 3)	-------------	-------------
Copper ... pounds	81,642,379	11,429,933	74,251,863	9,726,994
Fluorspar ... short tons	1,989	(2)	2,613	(2)
Gems and precious stones	-------------	(4)	-------------	(4)
Gold ... troy ounces	19,631	405,803	29,242	604,483
Gypsum ... short tons	(2)	(2)	(2)	(2)
Iron ore ... long tons	216,269	(2)	214,747	(2)
Lead ... short tons	3,480	556,829	8,026	1,011,330
Lime ... do	2,032	20,479	2,042	20,480
Lithium minerals ... do	(2)	(2)	(2)	(2)
Manganese ore ... long tons	1,966	(2)	2,190	37,237
Manganiferous ore ... do	81,440	(2)	87,334	(2)
Mica:				
Scrap ... short tons	988	16,683	776	12,741
Sheet ... pounds	46,104	5,824	(2)	(2)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Molybdenum ... pounds	(2)	(2)	(2)	(2)
Natural gas ... M cubic feet	921,000	75,000	1,019,000	48,500
Natural gasoline ... gallons	1,488,000	146,000	1,827,000	109,000
Ores (crude), etc.:				
Copper ... short tons	3,644,936	(5)	3,124,447	(5)
Copper-lead ... do	5	(5)	2,893	(5)
Dry and siliceous (gold and silver) ... do	25,876	(5)	31,692	(5)
Lead ... do	22,508	(5)	10,678	(5)
Lead-zinc ... do	17,160	(5)	215,138	(5)
Zinc ... do	115,409	(5)	57,336	(5)
Petroleum ... barrels	1,666,000	3,270,000	1,226,000	1,680,000
Pumice ... short tons	-------------	-------------	25	125
Salt ... do	(2)	(2)	(2)	(2)
Sand and gravel ... do	128,577	86,805	360,020	226,990
Silver ... troy ounces	450,934	281,383	890,083	504,677
Stone ... short tons	(2)	(2)	(2)	(2)
Zinc ... do	12,052	1,807,860	29,802	3,814,592
Miscellaneous [6]	-------------	1,953,725	-------------	1,470,961
Total value, eliminating duplications	-------------	28,513,991	-------------	28,608,776

[1] Figures obtained through cooperation with Bureau of the Census.

[2] Value included under "Miscellaneous."

[3] Value not included in total value for State.

[4] No canvass.

[5] Not valued as ore; value of recoverable metal content included under the metals.

[6] Includes minerals indicated by "2" above.

Mineral production of New York in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Aluminum.....pounds..	(1 2)	(1 2)	(1 2)	(1 2)
Cement.....barrels..	[3] 8,535,862	[3] $14,864,066	[3] 10,531,092	[3] $16,380,090
Clay products.....		[4] 28,999,053		[4] 25,476,896
Clay, raw.....short tons..	13,688	[2] 98,616	7,411	[2] 51,112
Coke.....do....	2,827,805	[2] 17,455,226	3,602,642	[2] 24,125,451
Diatomite.....do....	187	12,770	216	14,846
Emery.....do....	386	3,641	(1)	(1)
Feldspar (crude).....long tons..	15,517	157,865	12,020	96,446
Ferro-alloys.....do....	104,198	[2] 13,045,938	114,242	[2] 12,138,392
Garnet, abrasive.....short tons..	5,812	494,050	(1)	(1)
Graphite, artificial.....pounds..	21,163,986	(1 2)	12,257,239	(1 2)
Gypsum.....short tons..	1,723,460	16,794,589	1,675,501	14,889,390
Iron ore:				
Sold to furnaces.....long tons..	659,711	3,015,586	936,850	4,568,224
Sold for paint.....do....	(1)	(1)	(1)	(1)
Iron, pig.....do....	2,389,665	[2] 44,970,196	2,401,432	[2] 40,803,579
Lime.....short tons..	107,326	1,016,647	98,071	905,116
Magnesium.....pounds..	141,350	[2] 171,030	146,450	[2] 278,400
Marl, calcareous.....short tons..			38	73
Millstones.....		23,629		26,015
Mineral waters.....gallons sold..	(5)	(5)	(5)	(5)
Natural gas.....M cubic feet..	7,027,000	4,499,000	5,908,000	3,841,000
Natural gasoline.....gallons..	539,000	66,000	449,000	38,000
Ore (zinc).....short tons..	42,500	(6)	43,480	(6)
Peat.....do....	(1)	(1)	(5)	(5)
Petroleum.....barrels..	1,956,000	7,200,000	2,242,000	7,110,000
Pyrites.....long tons..	7,635	(1)		
Salt.....short tons..	2,001,580	6,564,829	1,964,080	6,121,461
Sand and gravel.....do....	19,334,360	11,585,652	19,896,766	12,157,612
Sand-lime brick.....thousands..	[4] 11,510	[4] 158,283	[4] 10,991	[4] 146,414
Silica (quartz).....short tons..	2,135	13,121	520	2,597
Slate.....		913,814		802,437
Stone.....short tons..	9,708,700	13,713,620	[7] 10,651,610	[7] 15,830,959
Talc.....do....	83,231	1,030,075	94,553	1,191,453
Zinc.....do....	5,041	756,150	3,750	480,000
Miscellaneous [8].....		28,831,260		30,248,904
Total value, eliminating duplications.....		112,016,262		112,209,533

[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Exclusive of natural cement, value for which is included under "Miscellaneous."

[4] Figures obtained through cooperation with Bureau of the Census.

[5] No canvass.

[6] Not valued as ore; value of recoverable metal content included under the metal.

[7] Exclusive of basalt, value for which is included under "Miscellaneous."

[8] Includes minerals indicated by "1," "3," and "7" above.

Mineral production of North Carolina in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Clay products	----------	[3] $4,256,901	----------	[3] $3,860,950
Clay, raw ... short tons	20,769	[2] 331,562	20,384	[2] 327,688
Coal ... do	57,939	243,000	53,377	191,000
Copper ... pounds	1,468,700	205,618	5,443,115	713,048
Feldspar (crude) ... long tons	91,433	602,020	100,756	612,214
Gems and precious stones	----------	(4)	----------	(4)
Gold ... troy ounces	79	1,631	49	1,015
Iron ore:				
Sold to furnaces ... long tons	14,798	31,645	32,528	81,753
Sold for paint ... do	400	(1)	----------	----------
Lime ... short tons	(1)	(1)	(1)	(1)
Manganese ore ... long tons	55	(1)	----------	----------
Marl, calcareous ... short tons	400	1,200	(1)	(1)
Mica:				
Scrap ... do	2,880	54,048	2,995	50,505
Sheet ... pounds	700,313	150,362	665,360	114,514
Micaceous minerals (biotite and muscovite schist) ... short tons	(1)	(1)	(1)	(1)
Millstones	----------	3,450	----------	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ores (crude):				
Copper ... short tons	15,150	(5)	38,400	(5)
Dry and siliceous (gold and silver) ... do	420	(5)	----------	----------
Sand and gravel ... do	1,630,789	968,021	1,462,808	871,416
Silica (quartz) ... do	2,134	17,457	3,396	19,853
Silver ... troy ounces	21	13	5	3
Stone ... short tons	[6] 1,843,480	[6] 4,005,087	[6] 2,250,870	[6] 4,913,177
Sulphuric acid [7] ... do	(1 2)	(1 2)	----------	----------
Talc and soapstone ... do	(1)	(1)	(1)	(1)
Miscellaneous [8]	----------	5,935,602	----------	6,242,623
Total value, eliminating duplications	----------	10,992,793	----------	11,703,671

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of marble and unclassified stone in 1926 and of marble in 1927, value for which is included under "Miscellaneous."
[7] From copper smelting.
[8] Includes minerals indicated by "1" and "6" above.

Mineral production of North Dakota in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products	----------	(1 2)	----------	[1] $130,733
Clay, raw ... short tons	(2 3)	(2 3)	18	[3] 315
Coal ... do	1,370,244	$2,378,000	1,527,939	2,604,000
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	(2)	(2)	200	100
Sand and gravel ... short tons	653,950	240,525	343,820	134,830
Miscellaneous [5]	----------	186,685	----------	----------
Total value, eliminating duplications	----------	2,804,837	----------	2,869,663

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "2" above.

Mineral production of Ohio in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Bromine..........pounds..			(1)	(1)
Calcium chloride..........short tons..	(1)	(1)	(1)	(1)
Cement..........barrels..	[2] 7,422,720	[2] $12,831,503	[2] 8,727,879	[2] $14,242,901
Clay products..........		[3] 97,873,102		[3] 92,595,130
Clay, raw..........short tons..	338,614	[4] 850,260	325,135	[4] 799,932
Coal..........do....	27,872,488	54,759,000	15,799,697	30,376,000
Coke..........do....	[5] 7,547,836	[4] [5] 40,344,524	[5] 7,213,619	[4] [5] 34,684,465
Ferro-alloys..........long tons..	114,796	[4] 3,779,525	99,636	[4] 3,178,165
Grindstones and pulpstones..........short tons..	28,969	1,150,135	23,501	881,537
Gypsum..........do....	521,205	5,797,221	474,320	5,041,879
Iron, pig..........long tons..	9,177,127	[4] 176,433,401	8,184,066	[4] 150,125,790
Lime..........short tons..	1,056,589	10,348,880	987,726	9,497,324
Marl, calcareous..........do....	(1)	(1)	(1)	(1)
Mineral paints, zinc and lead pigments..do....	(1 4)	(1 4)	(1 4)	(1 4)
Mineral waters..........gallons sold..	(6)	(6)	(6)	(6)
Natural gas..........M cubic feet..	47,363,000	25,403,000	51,381,000	28,881,000
Natural gasoline..........gallons..	10,817,000	1,402,000	12,167,000	1,062,000
Petroleum..........barrels..	7,272,000	19,180,000	7,593,000	14,970,000
Pyrites..........long tons..	200	(1)		
Rubbing stones, scythestones, and whetstones..........short tons..	846	26,596	319	49,495
Salt..........do....	1,164,400	3,209,473	1,203,170	3,130,236
Sand and gravel..........do....	11,716,926	7,840,316	13,187,415	9,085,413
Sand and sandstone (finely ground)......do....			16,220	154,344
Sand-lime brick..........thousands..	(1 3)	(1 3)	(1 3)	(1 3)
Stone..........short tons..	13,103,140	13,763,207	[7] 15,631,240	[7] 16,769,636
Sulphuric acid [8]..........do....	(1 4)	(1 4)	(1 4)	(1 4)
Miscellaneous [9]..........		4,574,463		5,087,536
Total value, eliminating duplications....		253,883,995		226,962,529

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Value not included in total value for State.
[5] Exclusive of beehive coke, value for which is included under "Miscellaneous," but not in total value for State. Quantity of beehive coke produced in 1926 was 84,970 short tons; Bureau of Mines not at liberty to publish figures for 1927.
[6] No canvass.
[7] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1," "2," "5," and "7" above.

Mineral production of Oklahoma in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asphalt (native)..........short tons..	37,010	$121,830	(1)	(1)
Calcium chloride..........do....	(1)	(1)	(1)	(1)
Cement..........barrels..	(1)	(1)	(1)	(1)
Chats..........short tons..	410,000	81,000	388,000	$69,000
Clay products..........		[2] 1,504,744		[2] 1,693,669
Coal..........short tons..	2,842,673	9,042,000	3,818,054	11,570,000
Gypsum..........do....	324,021	2,301,049	271,484	2,073,944
Lead..........do....	69,704	11,152,640	51,680	6,511,680
Lime..........do....	257	2,185	(1)	(1)
Mineral waters..........gallons sold..	(3)	(3)	(3)	(3)
Natural gas..........M cubic feet..	286,421,000	42,140,000	326,864,000	41,391,000
Natural gasoline..........gallons..	475,716,000	41,433,000	548,109,000	29,114,000
Ores (crude), etc.:				
Lead..........short tons..			1,000	(4)
Lead-zinc..........do....	9,577,900	(4)	6,986,300	(4)
Zinc..........do....	1,356,100	(4)	2,945,100	(4)
Petroleum..........barrels..	179,195,000	413,900,000	277,775,000	397,200,000
Salt..........short tons..	(1)	(1)	(1)	(1)
Sand and gravel..........do....	1,556,175	978,590	2,074,963	1,331,222
Stone..........do....	[5] 1,555,580	[5] 1,485,436	[5] 1,720,050	[5] 1,514,538
Tripoli..........do....	6,799	111,054	7,872	124,069
Zinc..........do....	272,567	40,885,050	206,611	26,446,208
Miscellaneous [6]..........		4,380,115		5,555,402
Total value, eliminating duplications....		569,518,693		524,594,732

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included under the metals.
[5] Exclusive of sandstone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Oregon in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Briquets, fuel ---------- short tons..	(1 2)	(1 2)	(1 2)	(1 2)
Cement ---------- barrels..	(1)	(1)	(1)	(1)
Clay products ----------	----------	(1 3)	----------	[3 4] $656,563
Clay, raw ---------- short tons..	473	[2] $1,009	2,570	[2] 2,834
Coal ---------- do....	(1)	(1)	(1)	(1)
Copper ---------- pounds..	296,454	41,504	488,200	63,954
Diatomite ---------- short tons..	(1)	(1)	(1)	(1)
Gems and precious stones ----------	----------	(5)	----------	(5)
Gold ---------- troy ounces..	13,243	273,759	14,676	303,383
Lead ---------- short tons..	6	924	3	334
Lime ---------- do....	785	13,930	1,105	21,350
Mercury ---------- flasks..	----------	----------	2,082	242,761
Mineral waters ---------- gallons sold..	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Copper ---------- short tons..	5,632	(6)	16,214	(6)
Dry and siliceous (gold and silver) --- do....	16,095	(6)	10,625	(6)
Platinum and allied metals ---------- troy ounces..	44	5,264	25	2,432
Sand and gravel ---------- short tons..	2,568,730	1,530,794	2,415,069	1,438,798
Silver ---------- troy ounces..	29,733	18,553	45,830	25,986
Stone ---------- short tons..	2,139,910	2,152,512	1,863,830	1,951,631
Miscellaneous [7] ----------	----------	3,585,199	----------	2,912,900
Total value, eliminating duplications ----------	----------	6,941,355	----------	6,821,224

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "[1]" and "[4]" above.

Mineral production of Pennsylvania in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Briquets, fuel ---------- short tons..	163,707	[1] $1,102,835	152,913	[1] $997,302
Cement ---------- barrels..	[2] 41,395,604	[2] 70,437,218	[2] 42,909,513	[2] 66,711,069
Clay products ----------	----------	[3] 55,041,270	----------	[3] 50,988,821
Clay, raw ---------- short tons..	855,832	[1] 2,563,374	897,798	[1] 2,403,428
Coal:				
Anthracite ---------- do....	84,437,452	474,164,252	80,095,564	420,941,726
Bituminous ---------- do....	153,041,638	325,618,000	132,964,639	272,714,000
Coke ---------- do....	21,922,976	[1] 96,318,119	16,777,291	[1] 67,170,075
Copper [4] ---------- pounds..	1,018,536	142,595	1,735,800	227,390
Feldspar (crude) ---------- long tons..	1,484	4,492	3,938	24,257
Ferro-alloys ---------- do....	376,301	[1] 35,975,381	344,032	[1] 32,137,339
Gems and precious stones ----------	----------	(5)	----------	(5)
Gold [4] ---------- troy ounces..	22	450	300	6,201
Iron ore:				
Sold to furnaces ---------- long tons..	1,088,634	2,483,056	1,124,883	2,559,916
Sold for paint ---------- do....	2,215	(6)	(6)	(6)
Iron, pig ---------- do....	13,142,528	[1] 263,238,184	11,145,334	[1] 212,179,275
Lime ---------- short tons..	794,196	6,303,312	813,571	6,105,241
Mineral paints, zinc and lead pigments -- do....	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters ---------- gallons sold..	(5)	(5)	(5)	(5)
Natural gas ---------- M cubic feet..	107,089,000	50,040,000	105,709,500	49,135,000
Natural gasoline ---------- gallons..	20,343,000	2,454,000	16,744,000	1,648,000
Peat ---------- short tons..	(6)	(6)	(5)	(5)
Petroleum ---------- barrels..	8,961,000	31,930,000	9,526,000	29,150,000
Potassium salts ---------- short tons..	(6)	(6)	(6)	(6)
Sand and gravel ---------- do....	12,873,953	11,695,218	13,832,181	12,040,406
Sand and sandstone (finely ground) ------ do....	(6)	(6)	(6)	(6)
Sand-lime brick ---------- thousands..	(3 6)	(3 6)	(3 6)	(3 6)
Silica (quartz) ---------- short tons..	(6)	(6)	(6)	(6)
Silver [4] ---------- troy ounces..	544	339	2,000	1,134
Slate ----------	----------	5,413,177	----------	4,769,432
Stone ---------- short tons..	[7] 16,628,770	[7] 19,157,336	16,015,480	18,999,592
Sulphuric acid (60° Baumé) [8] ---------- do....	152,513	[1] 1,447,000	159,112	[1] 1,553,000
Talc ---------- do....	(6)	(6)	(6)	(6)
Tripoli (rottenstone) ---------- do....	(6)	(6)	(6)	(6)
Miscellaneous [9] ----------	----------	14,064,462	----------	13,517,594
Total value, eliminating duplications ----------	----------	1,055,766,077	----------	936,773,189

[1] Value not included in total value for State.
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Copper, gold, and silver were recovered from pyritiferous magnetite. The quantity of such ore was 993,450 short tons in 1926 and 1,132,010 short tons in 1927; it is included in the figures shown for iron ore.
[5] No canvass.
[6] Value included under "Miscellaneous."
[7] Exclusive of serpentine, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "[2]," "[6]," and "[7]" above.

Mineral production of Rhode Island in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		(1 2)		(1 2)
Coke short tons	(1 3)	(1 3)	(1 3)	(1 3)
Graphite, amorphous do	(1)	(1)	(1)	(1)
Lime do	2, 857	$42, 535	2, 937	$43, 342
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Sand and gravel short tons	381, 856	90, 538	271, 065	303, 639
Stone do	[5] 252, 280	[5] 895, 718	[5] 153, 400	[5] 734, 164
Miscellaneous [6]		1, 446, 495		1, 360, 219
Total value, eliminating duplications		1, 339, 398		1, 310, 756

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of limestone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of South Carolina in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Barite short tons	(1)	(1)	(1)	(1)
Clay products		[2 3] $1,869,420		[2 3] $1, 802, 772
Clay, raw short tons	62, 173	[4] 660, 442	81, 010	[4] 743, 742
Gold troy ounces	15	313		
Marl, calcareous short tons	(1)	(1)	(1)	(1)
Mica:				
Scrap do	(1)	(1)		
Sheet pounds	(1)	(1)		
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Sand and gravel short tons	513, 698	231, 802	893, 772	397, 781
Stone do	881, 180	1, 505, 869	1, 197, 870	1, 992, 558
Miscellaneous [6]		69, 805		58, 026
Total value, eliminating duplications		3, 677, 209		4, 251, 137

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by "1" and "3" above.

Mineral production of South Dakota in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products		(1 2)		
Clay, raw ... short tons	1,810	[3] $17,800	1,056	[3] $4,194
Coal ... do	14,428	42,000	12,507	38,000
Columbite ... pounds	2,100	650	1,100	378
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)
Flint lining for tube mills ... short tons	(1)	(1)	(1)	(1)
Gems and precious stones		(4)		(4)
Gold ... troy ounces	279,529	5,778,376	322,032	6,656,987
Gypsum ... short tons	(1)	(1)	(1)	(1)
Lead ... do			69	8,694
Lime ... do	(1)	(1)	(1)	(1)
Lithium minerals ... do	(1)	(1)	(1)	(1)
Mica:				
Scrap ... do	835	15,907	(1)	(1)
Sheet ... pounds	(1)	(1)		
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	10,100	14,000	92,000	136,500
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	1,415,785	(5)	1,376,583	(5)
Pebbles for grinding ... do	1,900	22,000		
Sand and gravel ... do	2,013,350	286,591	1,162,823	231,218
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silver ... troy ounces	82,186	51,284	96,171	54,529
Stone ... short tons	211,340	472,032	264,500	535,232
Tin (metallic equivalent) ... do			(6)	200
Tungsten ore (60 per cent concentrates) ... do	90	41,900	141	(1)
Miscellaneous [7]		870,618		802,214
Total value, eliminating duplications		7,595,358		8,463,952

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] 325 pounds.
[7] Includes minerals indicated by "1" above.

Mineral production of Tennessee in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Aluminum...pounds..	(1 2)	(1 2)	(1 2)	(1 2)
Barite...short tons..	20,910	$155,780	20,537	$129,999
Bauxite...long tons..	(1)	(1)		
Cement...barrels..	5,053,528	8,352,095	4,343,337	6,580,732
Clay products...		[3] 5,105,827		[3] [4] 3,728,380
Clay, raw...short tons..	173,513	[2] 652,229	149,629	[2] 661,813
Coal...do....	5,788,741	10,975,000	5,783,367	10,645,000
Coke...do....	241,034	[2] 1,233,499	227,129	[2] 1,149,604
Copper...pounds..	18,606,664	2,604,933	14,940,595	1,957,217
Ferro-alloys...long tons..	(1 2)	(1 2)	(1 2)	(1 2)
Gold...troy ounces..	417	8,622	426	8,816
Iron ore:				
Sold to furnaces...long tons..	138,307	312,109	121,220	274,620
Sold for paint...do....	512	(1)	(1)	(1)
Iron, pig...do....	113,029	[2] 2,544,825	87,971	[2] 1,911,380
Iron sinter from copper sulphide ore...do....	38,881	(1)	45,983	(1)
Lead...short tons..	800	128,000		
Lime...do....	173,363	1,319,303	181,385	1,266,326
Manganese ore...long tons..	1,555	(1)	498	8,182
Manganiferous ore...do....	953	(1)	487	3,442
Mineral waters...gallons sold..	(5)	(5)	(5)	(5)
Natural gas...M cubic feet..	11,500	1,900	9,000	2,200
Ores (crude), etc.:				
Copper...short tons..	608,040	(6)	630,955	(6)
Lead...do....	4,000	(6)		
Zinc...do....	502,400	(6)	521,200	(6)
Petroleum...barrels..	43,000	100,000	60,000	90,000
Phosphate rock...long tons..	455,395	1,980,613	481,769	2,318,785
Sand and gravel...short tons..	2,254,350	1,751,336	2,479,249	1,842,144
Silver...troy ounces..	104,000	64,896	81,460	46,188
Slate...		(1)		(1)
Stone...short tons..	[7] 1,693,080	[7] 4,170,016	2,145,390	6,430,631
Sulphuric acid (60° Baumé) [8]...do....	399,691	(1 2)	(1 2)	(1 2)
Tripoli...do....	(1)	(1)	(1)	(1)
Zinc...do....	12,098	1,814,700	10,400	1,331,200
Miscellaneous [9]...		9,866,340		10,406,824
Total value, eliminating duplications....		39,296,668		37,874,981

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[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Figures obtained through cooperation with Bureau of the Census.

[4] Exclusive of pottery, value for which is included under "Miscellaneous."

[5] No canvass.

[6] Not valued as ore; value of recoverable metal content included under the metals

[7] Exclusive of sandstone, value for which is included under "Miscellaneous."

[8] From copper smelting.

[9] Includes minerals indicated by "1," "4," and "7" above.

Mineral production of Texas in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	289,980	$825,610	376,770	$1,254,500
Cement barrels	5,042,359	9,522,701	5,692,350	10,232,908
Clay products		[1] 6,010,981		[1] 6,417,017
Clay, raw short tons	2,682	[2] 16,754	3,193	[2] 19,063
Coal do	1,091,158	1,751,000	1,326,385	1,998,000
Copper pounds	12,620	1,767	21,458	2,811
Fuller's earth short tons	30,258	300,169	26,938	283,400
Gems and precious stones		(3)		(3)
Gold troy ounces	110	2,270	396	8,192
Graphite, crystalline pounds	(4)	(4)	(4)	(4)
Gypsum short tons	533,156	4,126,400	508,382	4,003,456
Lead do	42	6,711	244	30,743
Lime do	78,293	706,153	80,796	733,678
Marl, greensand do	(4)	(4)	(4)	(4)
Mercury flasks	(4)	(4)	(4)	(4)
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Natural gas M cubic feet	175,392,000	28,165,000	254,063,000	37,424,800
Natural gasoline gallons	243,093,000	22,760,000	320,723,000	18,347,000
Ores (crude), etc.:				
Copper short tons	61	(5)		
Dry and siliceous (gold and silver) do	33,912	(5)	50,719	(5)
Lead do	69	(5)	40	(5)
Petroleum barrels	166,916,000	308,700,000	217,389,000	248,550,000
Salt short tons	(4)	(4)	54,270	399,171
Sand and gravel do	5,383,450	3,187,662	9,695,152	4,694,134
Sand-lime brick thousands	(1 4)	(1 4)	(1 4)	(1 4)
Silver troy ounces	447,237	279,076	1,034,866	586,769
Stone short tons	3,117,020	2,595,018	3,267,940	2,534,866
Sulphur long tons	(4)	(4)	(4)	(4)
Miscellaneous [6]		31,646,212		37,001,975
Total value, eliminating duplications		420,586,730		374,503,420

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[1] Figures obtained through cooperation with Bureau of the Census.

[2] Value not included in total value for State.

[3] No canvass.

[4] Value included under "Miscellaneous."

[5] Not valued as ore; value of recoverable metal content included under the metals.

[6] Includes minerals indicated by "4" above.

Mineral production of Utah in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Arsenious oxide short tons	[1] 3,756	[1] $236,753	4,231	$327,956
Asphalt (native) do	42,430	886,730	42,940	933,570
Bismuth pounds			(2)	(2)
Cement barrels	(2)	(2)	(2)	(2)
Clay products		[3] [4] 929,782		[3] [4] 1,024,559
Clay, raw short tons	8,152	[5] 107,963	17,313	[5] 108,380
Coal do	4,373,793	10,362,000	4,781,480	11,084,000
Coke do	306,231	(2 5)	282,048	(2 5)
Copper pounds	257,464,482	36,045,027	256,933,278	33,658,259
Diatomite short tons			35	700
Gems and precious stones		(6)		(6)
Gold troy ounces	182,763	3,778,046	193,909	4,008,451
Gypsum short tons	36,333	195,535	(2)	(2)
Iron ore long tons	296,943	411,611	222,879	(2)
Iron, pig do	(2 5)	(2 5)	(2 5)	(2 5)
Lead short tons	147,635	23,621,602	151,285	19,061,913
Lime do	29,953	348,509	48,882	397,088
Manganese ore long tons			27	(2)
Manganiferous ore do	(2)	(2)	239	(2)
Marl, calcareous short tons			(2)	(2)
Mineral soap do	(2)	(2)		
Natural gas M cubic feet			(2)	(2)
Ores (crude), etc.:				
Copper short tons	13,949,866	(7)	13,879,173	(7)
Copper-lead do			73,878	(7)
Dry and siliceous (gold and silver) do	301,213	(7)	245,344	(7)
Lead do	383,857	(7)	337,734	(7)
Lead-zinc do	1,218,635	(7)	1,220,945	(7)
Zinc do	2,573	(7)		
Petroleum barrels	525	656	(2)	(2)
Potassium salts short tons	(2)	(2)		
Salt do	77,350	422,317	74,690	334,732
Sand and gravel do	1,100,918	227,574	903,244	272,609
Sand-lime brick thousands			(2 3)	(2 3)
Silver troy ounces	19,358,581	12,079,755	18,606,950	10,550,141
Stone short tons	732,960	623,608	[8] 739,830	[8] 561,932
Sulphur long tons	(2)	(2)	(2)	(2)
Uranium and vanadium ores short tons	1,083	36,000	(2)	(2)
Zinc do	47,590	7,138,454	49,593	6,347,868
Miscellaneous [9]		6,865,325		6,364,481
Total value, eliminating duplications		98,985,218		90,388,455

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[1] Estimate by the Bureau of Mines.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] Value not included in total value for State.
[6] No canvass
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of marble, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "2," "4," and "8" above.

Mineral production of Vermont in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		(1 2)		(1 2)
Clay, raw ... short tons	2,027	[3] $11,364	(2 3)	(2 3)
Copper ... pounds	473,200	66,248	208,224	$27,278
Gold ... troy ounces	2	41		
Lime ... short tons	56,378	677,944	61,024	683,440
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ore (copper) ... short tons	14,970	(5)	4,363	(5)
Sand and gravel ... do	141,554	25,535	171,250	39,143
Scythestones ... do	(2)	(2)	(2)	(2)
Silver ... troy ounces	1,965	1,227	821	465
Slate		4,267,041		4,108,911
Stone ... short tons	330,230	9,244,465	321,970	9,216,116
Talc ... do	53,510	514,527	54,688	503,716
Miscellaneous [6]		158,133		136,872
Total value, eliminating duplications		14,955,161		14,702,891

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Includes minerals indicated by "2" above.

Mineral production of Virginia in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Barite ... short tons	(1)	(1)	(1)	(1)
Briquets, fuel ... do	63,862	[2] $495,791	(1 2)	(1 2)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products		[3 4] 3,755,980		[3 4] $2,932,998
Clay, raw ... short tons	29,945	[2] 243,197	25,497	[2] 211,869
Coal ... do	14,133,386	27,203,000	12,916,042	23,203,000
Coke ... do	370,983	[2] 1,716,716	316,754	[2] 1,413,595
Emery ... do			(1)	(1)
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)
Ferro-alloys ... do	(1 2)	(1 2)	(1 2)	(1 2)
Gem feldspar ... pounds			2,500	2,500
Gold ... troy ounces	11	220		
Gypsum ... short tons	(1)	(1)	(1)	(1)
Iron ore ... long tons	49,703	162,446	66,897	172,877
Iron, pig ... do	105,019	[2] 2,322,451	84,920	[2] 1,782,538
Lead ... short tons	2,450	392,000	2,393	301,518
Lime ... do	188,696	1,453,095	178,426	1,317,581
Manganese ore ... long tons	3,792	(1)	3,212	76.222
Manganiferous ore ... do	2,135	(1)	1,206	8,000
Marl, calcareous ... short tons	23,927	48,943	24,225	77,851
Mica:				
Scrap ... do	(1)	(1)	(1)	(1)
Sheet ... pounds	(1)	(1)	(1)	(1)
Millstones		15,295		(1)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Lead-zinc ... short tons	144,300	(6)	201,679	(6)
Pyrites ... long tons	(1)	(1)	(1)	(1)
Salt ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	1,791,198	1,225,693	1,502,248	1,217,450
Sand and sandstone (finely ground) ... do	(1)	(1)	(1)	(1)
Silica (quartz) ... do	(1)	(1)	(1)	(1)
Slate		[7] 331,651		[7] 398,612
Stone ... short tons	[8] 3,047,220	[8] 3,504,671	[8] 3,140,170	[8] 3,320,385
Talc and soapstone ... do	(1)	(1)	(1)	(1)
Titanium minerals:				
Ilmenite ... do	(1)	(1)	(1)	(1)
Rutile ... do	(1)	(1)	(1)	(1)
Zinc ... do	5,830	874,500	8,325	1,065,600
Miscellaneous [9]		9,114,955		8,530,620
Total value, eliminating duplications		46,136,458		41,322,998

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of granules, etc., value for which is included under "Miscellaneous."
[8] Exclusive of marble, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1," "4," "7," and "8" above.

Mineral production of Washington in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Briquets, fuel..........short tons..	(1 2)	(1 2)	(1 2)	(1 2)
Cement..........barrels..	(1)	(1)	(1)	(1)
Clay products..........	....	[3] $2,583,333	....	[3] $2,518,250
Clay, raw..........short tons..	12,947	[2] 31,515	31,463	[2] 40,428
Coal..........do....	2,586,568	9,350,000	2,635,062	9,222,000
Coke..........do....	67,286	[2] 518,053	71,271	[2] 530,759
Copper..........pounds..	1,351,890	189,265	1,685,848	220,846
Diatomite..........short tons..	140	1,400	760	13,900
Gold..........troy ounces..	9,341	193,092	19,514	403,380
Iron ore..........long tons..	1,702	(1)	550	(1)
Lead..........short tons..	2,273	363,698	478	60,165
Lime..........do....	23,783	298,014	23,959	382,294
Magnesite..........do....	79,560	596,700	77,740	583,050
Magnesium sulphate (natural)..........pounds..	(1)	(1)	....	....
Manganese ore..........long tons..	3,162	(1)	....	....
Mercury..........flasks..	489	44,941	566	65,996
Mineral waters..........gallons sold..	(4)	(4)	(4)	(4)
Ores (crude), etc:				
Copper..........short tons..	25,297	(5)	37,564	(5)
Dry and siliceous (gold and silver)...do....	17,599	(5)	43,450	(5)
Lead..........do....	7,659	(5)	1,648	(5)
Lead-zinc..........do....	603	(5)	1,232	(5)
Zinc..........do....	3,185	(5)	35,307	(5)
Pulpstones..........do....	(1)	(1)	(1)	(1)
Rubbing stones..........do....	(1)	(1)	(1)	(1)
Sand and gravel..........do....	3,910,577	1,704,234	4,423,246	1,570,999
Silica (quartz)..........do....	(1)	(1)	273	2,070
Silver..........troy ounces..	171,649	107,109	155,850	88,367
Sodium sulphate from natural sources..........short tons..	(1)	(1)	(1)	(1)
Stone..........do....	[6] 461,570	[6] 979,482	975,850	958,841
Zinc..........do....	522	78,327	640	81,901
Miscellaneous [7]..........	....	5,324,668	....	6,363,918
Total value, eliminating duplications....	....	21,256,952	....	21,965,917

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of marble, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of West Virginia in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Briquets, fuel..........short tons..	(1 2)	(1 2)	(1 2)	(1 2)
Bromine..........pounds..	87,870	$26,672	(1)	(1)
Calcium chloride..........short tons..	4,960	55,208	3,455	$33,550
Cement..........barrels..	(1)	(1)	(1)	(1)
Clay products..........	....	[3] 16,121,172	....	[3] 16,320,373
Clay, raw..........short tons..	63,446	[2] 113,007	48,332	[2] 85,304
Coal..........do....	143,509,340	264,736,000	145,122,447	249,730,000
Coke..........do....	1,713,461	[2] 6,918,103	1,923,427	[2] 6,840,358
Ferro-alloys..........long tons..	(1 2)	(1 2)	(1 2)	(1 2)
Grindstones and pulpstones..........short tons..	7,082	630,440	7,113	616,177
Iron, pig..........long tons..	364,302	(1 2)	504,816	(1 2)
Lime..........short tons..	267,464	1,719,590	244,950	1,643,109
Marl, calcareous..........do....	(1)	(1)	(1)	(1)
Mineral waters..........gallons sold..	(4)	(4)	(4)	(4)
Natural gas..........M cubic feet..	180,223,000	76,396,000	162,375,000	67,994,000
Natural gasoline..........gallons..	63,807,000	7,706,000	64,192,000	5,421,000
Petroleum..........barrels..	5,946,000	20,560,000	6,023,000	17,410,000
Salt..........short tons..	23,180	170,953	22,600	167,155
Sand and gravel..........do....	2,563,113	3,095,743	2,522,617	2,879,631
Sand and sandstone (finely ground).....do....	(1)	(1)	(1)	(1)
Stone..........do....	3,211,650	3,402,327	3,171,120	2,962,922
Sulphuric acid [5]..........do....	(1 2)	(1 2)	(1 2)	(1 2)
Miscellaneous [6]..........	....	9,330,154	....	11,108,845
Total value, eliminating duplications....	....	395,941,940	....	366,643,205

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] From zinc smelting.
[6] Includes minerals indicated by "1" above.

Mineral production of Wisconsin in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Barite short tons	(1)	(1)	(1)	(1)
Briquets, fuel do	(1 2)	(1 2)	(1 2)	(1 2)
Cement barrels	(1)	(1)	(1)	(1)
Clay products		(1 3)		[3, 4] $1,228,338
Clay, raw short tons	220	[2] $220	(1 2)	(1 2)
Coke do	(1 2)	(1 2)	(1 2)	(1 2)
Iron ore:				
Sold to furnaces long tons	1,238,885	3,178,156	937,935	2,567,078
Sold for paint do	1,736	4,535	2,415	7,136
Iron, pig do	235,597	[2] 5,034,012	(1 2)	(1 2)
Lead short tons	1,546	247,360	2,069	260,694
Lime do	216,414	1,896,772	197,667	1,733,009
Manganiferous ore long tons			284,470	818,604
Marl, calcareous short tons			310	2,170
Mineral paints, zinc and lead pigments short tons	(1 2)	(1 2)	(1 2)	(1 2)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Lead short tons			1,000	(6)
Lead-zinc do	1,078,500	(6)	562,700	(6)
Zinc do	361,800	(6)	917,100	(6)
Sand and gravel do	7,977,261	3,264,271	9,020,124	3,190,334
Sand-lime brick thousands	(1 3)	(1 3)	(1 3)	(1 3)
Silica (quartz) short tons	(1)	(1)	(1)	(1)
Stone do	[7] 2,852,070	[7] 4,937,661	[7] 3,104,240	[7] 5,181,631
Sulphuric acid [8] do	(1 2)	(1 2)	(1 2)	(1 2)
Zinc do	26,800	4,020,000	32,841	4,203,648
Miscellaneous [9]		14,277,716		16,331,880
Total value, eliminating duplications		20,711,736		21,776,847

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of basalt, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1," "4," and "7" above.

Mineral production of Wyoming in 1926 and 1927

Product	1926		1927	
	Quantity	Value	Quantity	Value
Clay products		(1 2)		[1] $101,708
Clay, raw short tons	4,409	[3] $96,853	7,500	[3] 121,163
Coal do	6,512,288	17,827,000	6,753,656	18,152,000
Gold troy ounces			58	1,200
Gypsum short tons	(2)	(2)	(2)	(2)
Iron ore long tons	630,387	(2)	602,877	(2)
Lime short tons	(2)	(2)	30	600
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Natural gas M cubic feet	46,567,000	4,669,000	43,581,600	3,269,800
Natural gasoline gallons	40,625,000	3,934,000	43,212,000	2,899,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) short tons			110	(5)
Petroleum barrels	25,776,000	51,020,000	21,307,000	29,830,000
Phosphate rock long tons	4,464	29,000	6,250	29,000
Sand and gravel short tons	941,292	139,273	1,360,475	494,065
Shale oil gallons			(6)	(7)
Silver troy ounces			5	3
Sodium salts (carbonate and sulphate) from natural sources short tons	(2)	(2)	(2)	(2)
Stone do	153,940	316,463	253,230	431,104
Miscellaneous [8]		1,053,330		958,120
Total value, eliminating duplications		78,988,066		56,166,600

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Bureau of Mines not at liberty to publish figures.
[7] No data available.
[8] Includes minerals indicated by "2" above.

PREFATORY NOTE TO THE REPORTS ON GOLD, SILVER, COPPER, LEAD, AND ZINC

By Frank J. Katz
Chief Engineer, Division of Mineral Statistics

In the mining industry, gold, silver, copper, lead, and zinc are closely related in both the genesis and the geologic occurrence of their ores, as well as in mining and in metallurgical treatment. Of their ores some contain all five metals, many contain three or four, and few contain only one. Gold and silver, for instance, almost everywhere show close genetic relations, and their ores are usually mined together. Lead and zinc constitute a similar pair. Copper ores almost invariably yield some silver and gold as well as copper, and most lead ores yield notable supplies of silver. Zinc ores in the Western States contribute also to the production of silver. All five metals may occur in commercial quantity in a single mine or, more commonly, in a single mining district. For these reasons each of these metals is treated in Mineral Resources in a general report, and all five metals are grouped together in "mine reports" descriptive of individual or geographically grouped States. These reports are printed in 15 pamphlets.

To facilitate advance publication each report is published separately at the earliest date possible. The general reports give figures of the output of the metals in the first marketable form, as obtained from the smelters, refineries, and mints, together with general reviews of the respective industries for the entire country. The figures given in the general reports represent the final official statistics of production for the country and of the States. The general report on gold and silver includes the statistics of recovered precious metals as determined by the Bureau of the Mint. The "mine reports" give figures of the production (called "mine production") as obtained from the mines, so far as possible in terms of recoverable metal in ores and other material sold or treated during the year; they also supply information in detail relative to the mining industry in the respective States, counties, and mining districts.

These reports, which appear as separate chapters in this volume, are as follows:

Gold and silver (general report).
Copper (general report).
Lead (general report).
Zinc (general report).
Silver, copper, lead, and zinc in the Central States (mine report).
Gold, silver, copper, lead, and zinc in the Eastern States (mine report).

Gold, silver, copper, lead, and zinc in Arizona (mine report).
Gold, silver, copper, lead, and zinc in California and Oregon (mine report).
Gold, silver, copper, lead, and zinc in Colorado (mine report).
Gold, silver, copper, lead, and zinc in Idaho and Washington (mine report).
Gold, silver, copper, lead, and zinc in Montana (mine report).
Gold, silver, copper, lead, and zinc in Nevada (mine report).
Gold, silver, copper, lead, and zinc in New Mexico and Texas (mine report).
Gold, silver, copper, and lead in South Dakota and Wyoming (mine report).
Gold, silver, copper, lead, and zinc in Utah (mine report).

In stating quantity of ores, concentrates, and similar material the short ton of 2,000 pounds is used throughout. The term "ore" as used here denotes any metalliferous material treated at the mine or shipped to reduction plants and paid for by those plants, whether or not it nets a profit to the miner. The ore classification is necessarily arbitrary, because of the varying factors affecting mining and treatment of ores. Dry and siliceous ores comprise gold and silver ores proper, as well as fluxing ores that carry considerable quantities of iron and manganese oxides and very small quantities of gold and silver and also gold and silver ores that carry copper, lead, or zinc on quantities too low to classify them as copper, lead, zinc, or mixed ores. The copper ores include the great disseminated copper deposits if the West, the copper ores of the Lake Superior region, and other ores in which copper is the most abundant base metal paid for. The lead and zinc ores are those in which lead or zinc is the only or chief base metal present, irrespective of their precious-metal content. The mixed ores are those whose commercial value depends on the recoverable or recovered contents of two or more base metals in addition to any precious metals they may contain. If one of the metals, though present in sufficient quantity, is not recovered, that metal is disregarded in naming the ore. An improvement in metallurgy may later serve to change the name of such ore. The classification based on methods of treatment is the only satisfactory commercial classification.

It is to be understood, of course, that market values are not received by producers for metals in ore and intermediate products nor always for metals in marketable form, that payment is made in accordance with contracts for treatment or sale, and therefore that average daily quotations do not necessarily agree with average prices received.

Prices of silver, copper, lead, and zinc, 1850–1927

Year	Silver [1]	Copper [2]	Lead [3]	Zinc [4]	Year	Silver [1]	Copper [2]	Lead [3]	Zinc [4]
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1850	$1.32	$0.22	$0.05		1889	$0.94	$0.135	$0.039	$0.05
1851	1.34	.166	.05		1890	1.05	.156	.045	.055
1852	1.33	.22	.05		1891	.99	.128	.043	.05
1853	1.35	.22	.06	$0.055	1892	.87	.116	.041	.046
1854	1.35	.22	.06		1893	.78	.108	.037	.04
1855	1.34	.27	.07		1894	.63	.095	.033	.035
1856	1.34	.27	.066		1895	.65	.107	.032	.036
1857	1.35	.25	.06		1896	.68	.108	.03	.039
1858	1.34	.23	.06		1897	.60	.12	.036	.041
1859	1.36	.22	.055		1898	.59	.124	.038	.046
1860	1.35	.23	.056		1899	.60	.171	.045	.058
1861	1.33	.22	.05		1900	.62	.166	.044	.044
1862	1.35	.22	.06		1901	.60	.167	.043	.041
1863	1.345	.34	.06		1902	.53	.122	.041	.048
1864	1.345	.47	.07	.139	1903	.54	.137	.042	.054
1865	1.337	.392	.066		1904	.58	.128	.043	.051
1866	1.339	.342	.07		1905	.61	.156	.047	.059
1867	1.33	.254	.065		1906	.68	.193	.057	.061
1868	1.326	.23	.065		1907	.66	.20	.053	.059
1869	1.325	.242	.06		1908	.53	.132	.042	.047
1870	1.328	.212	.06		1909	.52	.13	.043	.054
1871	1.325	.241	.06		1910	.54	.127	.044	.054
1872	1.322	.356	.064		1911	.53	.125	.045	.057
1873	1.297	.280	.06		1912	.615	.165	.045	.069
1874	1.278	.220	.06		1913	.604	.155	.044	.056
1875	1.24	.227	.058	.07	1914	.553	.133	.039	.051
1876	1.16	.21	.061	.072	1915	.507	.175	.047	.124
1877	1.20	.19	.055	.06	1916	.658	.246	.069	.134
1878	1.15	.166	.036	.049	1917	.824	.273	.086	.102
1879	1.12	.186	.041	.052	1918	1.00	.247	.071	.091
1880	1.15	.214	.05	.055	1919	1.12	.186	.053	.073
1881	1.13	.182	.048	.052	1920	1.09	.184	.08	.081
1882	1.14	.191	.049	.053	1921	1.00	.129	.045	.05
1883	1.11	.165	.043	.045	1922	1.00	.135	.055	.057
1884	1.11	.13	.037	.044	1923	.82	.147	.07	.068
1885	1.07	.108	.040	.043	1924	.67	.131	.08	.065
1886	.99	.111	.046	.044	1925	.694	.142	.087	.076
1887	.98	.138	.045	.046	1926	.624	.14	.08	.075
1888	.94	.168	.044	.049	1927	.567	.131	.063	.064

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[1] Report of Director of the Mint, pp. 212–213, 1914. Equivalent value of fine ounce based on average price and average rate of exchange. For 1916, 1917, and 1919, dealers' buying price, New York. For 1918, early estimate furnished by the Bureau of the Mint. For 1920 to 1922, New York market price for domestic silver only. For 1923, average price under Pittman Act, from Jan. 1 to June 2, for domestic silver; average New York price for all silver after that period. For 1924 to 1927, average New York price for bar silver.

[2] Weed, W. H., Copper Handbook, vol. 11, pp. 1339, 1343, for years 1850–1903. By computation from data for years 1850–1860, p. 1339. U. S. Geological Survey computations for electrolytic copper since 1904. For 1916 and later years, average price all marketable grades.

[3] New York price, Ingalls, W. R., Lead and zinc in the United States, p. 203, 1908. U. S. Geological Survey since 1904. For 1916, outside spot quotations, New York. For 1917 and later years, average price all grades.

[4] New York price, 1875–1904, Ingalls, W. R., Lead and zinc in the United States, p. 342, 1908. St. Louis price, U. S. Geological Survey, since 1904. For 1915 and later years, average price all grades. Oral communication from C. E. Siebenthal, of the U. S. Geological Survey, for 1853 and 1864.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES[1]

By J. P. Dunlop

SUMMARY

The total value of the mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1927 increased less than 1 per cent in comparison with the corresponding value for 1926; there was a decrease of 6 in the number of mines producing. Of the total value in 1927 gold represented $17,074, silver $47,794, copper $2,924,933, lead $301,518, and zinc $16,836,047. The quantity of copper, zinc, and gold increased and the quantity of silver and lead decreased. The decrease in silver recovered was 21 per cent in quantity and 28 per cent in value. The quantity of zinc produced in 1927 was 29,000,000 pounds greater than that in 1926. The quantity of ore sold or treated increased 10 per cent.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the Mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1918–1927

Year	Mines producing	Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
			Fine ounces	Value	Fine ounces	Value
1918	(a)	2,355,688	694.27	$14,352	106,585	$106,585
1919	(a)	1,930,411	341.14	7,052	104,690	117,253
1920	(a)	2,418,500	411.91	8,515	112,183	122,279
1921	27	1,502,277	480.55	9,934	98,792	98,792
1922	29	2,274,175	620.22	12,821	80,935	80,935
1923	21	2,936,637	576.58	11,919	108,799	89,215
1924	16	2,851,932	799.88	16,535	97,628	65,411
1925	19	3,315,912	1,964.60	40,612	106,228	73,722
1926	21	2,902,670	694.23	14,351	106,539	66,480
1927	15	3,201,195	825.96	17,074	84,293	47,794

[a] Figures not available.

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[1] Mineral Resources, 1908, pt. 1, pp. 645 to 681, contains references to the geology of the Eastern States and gives a list of the U. S. Geological Survey, State survey, and other publications that deal with the geology and mines of those States; Mineral Resources, 1914, pt. 1, pp. 139 to 163, contains a historical review of the production of gold in the Southern Appalachian States and a list of U. S. Geological Survey publications on gold, silver, copper, lead, and zinc in the Eastern States.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1918–1927—Continued

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	17, 858, 535	$4, 411, 058	5, 158, 329	$366, 243	256, 260, 000	[b] $23, 319, 562	$28, 217, 800
1919	16, 596, 182	3, 086, 890	4, 378, 000	232, 034	241, 766, 000	[b] 22, 552, 371	25, 995, 600
1920	17, 138, 675	3, 153, 516	4, 003, 078	320, 246	206, 764, 000	[b] 20, 673, 444	24, 278, 000
1921	15, 397, 596	1, 986, 290			135, 422, 000	10, 521, 030	12, 616, 046
1922	15, 476, 497	2, 089, 327	1, 472, 000	80, 960	188, 082, 000	13, 616, 900	15, 881, 033
1923	20, 487, 395	3, 011, 647	2, 500, 000	175, 000	199, 180, 000	14, 765, 885	18, 053, 666
1924	19, 450, 329	2, 547, 993	4, 424, 000	353, 920	212, 148, 000	16, 875, 606	19, 859, 465
1925	20, 824, 058	2, 957, 016	5, 354, 000	465, 798	226, 814, 000	18, 531, 644	22, 068, 792
1926	21, 567, 100	3, 019, 394	6, 500, 000	520, 000	207, 196, 000	16, 365, 050	19, 985, 275
1927	22, 327, 734	2, 924, 933	4, 786, 000	301, 518	236, 340, 000	16, 836, 047	20, 127, 366

[b] Revised figures.

GOLD AND SILVER

In the Eastern States the output of gold in 1927 was $17,074, compared with $14,351 in 1926. The lode and placer gold mines, from which nearly all the gold produced in the Eastern States has come, supplied 36.5 per cent of the total in 1926; in 1927 no production was reported from lode gold mines. Placers yielded $2,057 in gold (12 per cent of the total) in 1927 and copper and magnetite ores $15,017. Gold mines in most districts were inactive, little capital went into development, and no siliceous ores were treated other than for experimental purposes. No gold was reported from Alabama, South Carolina, or Virginia. Three placers in Georgia yielded $1,042 in gold and three placers in North Carolina yielded $1,015. Refining of copper bullion from Tennessee and Pennsylvania yielded $15,017 in gold in 1927.

The value of the estimated production of gold of the Southern Appalachian States for the period 1799 to 1927 is $51,136,661.

All of the silver produced in 1927, except 12 ounces from placer bullion, was derived from copper ore and pyritiferous magnetite ore.

Mine production of gold and silver in the Eastern States in 1927, by States

State	Gold		Silver		Increase or decrease in value as compared with 1926	
	Fine ounces	Value	Fine ounces	Value	Gold	Silver
Georgia	50. 41	$1, 042	7	$4	−$2, 032	−$1
North Carolina	49. 10	1, 015	5	3	−616	−10
Pennsylvania	299. 98	6, 201	2, 000	1, 134	+5, 751	+795
South Carolina					−313	
Tennessee	426. 47	8, 816	81, 460	46, 188	+194	−18, 708
Vermont			821	465	−41	−762
Virginia					−220	
	825. 96	17, 074	84, 293	47, 794	+2, 723	−18, 686
Total, 1926	694. 23	14, 351	106, 539	66, 480	−26, 261	−7, 242

Mine production of gold and silver in the Eastern States in 1927, by sources, in fine ounces

State	Gold			Silver		
	Placers	Dry and siliceous ore	Copper ore	Placers	Dry and siliceous ore	Copper ore
Georgia	50.41			7		
North Carolina	49.10			5		
Pennsylvania			299.98			2,000
Tennessee			426.47			81,460
Vermont						821
	99.51		726.45	12		84,281
Total, 1926	80.54	172.85	440.84	3	27	106,509

COPPER

The mine production of copper in the Eastern States in 1927 was valued at $2,924,933, a decrease of $94,461 compared with 1926. The output was derived from copper ore from mines in Tennessee, North Carolina, and Vermont, and from copper concentrates recovered from Pennsylvania pyritiferous magnetite ore. The quantity of ore treated to produce this copper was 1,805,728 short tons. Exclusive of the magnetite ore, which was mined for its iron content and contained little copper, the average yield from copper ore was 1.53 per cent, or 30.6 pounds to the ton; this copper ore also yielded $0.082 in gold and silver to the ton. The copper concentrates from magnetite ore contained about 25 per cent of copper and some gold and silver. The copper concentrates shipped in 1927 were of much higher metal content than in previous years.

Copper ore directly smelted amounted to 334,373 tons, from which 12,434,975 pounds of copper was recovered. Copper and magnetite ores concentrated amounted to 1,471,355 tons, which yielded 43,916 tons of concentrates; 9,892,759 pounds of copper was recovered from these concentrates.

In 1927 the Fontana Mining Corporation in Swain County, N. C., shipped a large quantity of crude copper ore for smelting, and the American Metal Co. of Vermont, working the old Elizabeth mine in Orange County, Vt., shipped copper concentrates part of the year.

LEAD

In 1927 the only output of lead in the Eastern States reported to the Bureau of Mines was from mines in Virginia; the Embree mine in Tennessee was idle. The total quantity of lead recovered was 4,786,000 pounds, or 26 per cent less than in 1926. If the Embree mine is worked in 1928 and the new mill at Austinville, Va., is operated steadily, the lead output will increase considerably in 1928.

ZINC

The recoverable zinc in the ore mined in the Eastern States in 1927 was valued at $16,836,047.

[N. B.—The value of the zinc in New Jersey is not that of ore mined. It is the estimated smelting value of the recoverable zinc content of the ore after freight, haulage, smelting, and manufacturing charges are added.]

In 1927, 629,108 short tons of zinc ore was mined in New Jersey, 521,200 tons in Tennessee, and 43,480 tons in New York.

All of the zinc ore from Tennessee and New York went to concentrating plants. In Virginia 201,679 tons of lead-zinc ore was concentrated, yielding both lead and zinc concentrates.

The recoverable zinc, as metal or oxide, in the ore mined in New York in 1927 was 7,500,000 pounds, in Tennessee was 20,800,000 pounds, and in Virginia was 16,650,000 pounds. With higher grade ore at Mascot and larger and more efficient mills in New York and Virginia the yield of zinc in the Eastern States in 1928 may be much larger than in 1927.

REVIEW BY STATES

Alabama.—The value of the gold produced by mines in Alabama during the period 1830 to 1927 was $766,746. None has been reported since 1923. No lode mine was worked in 1927, and practically no prospect work was done at any placer property.

Georgia.—The value of the gold produced in Georgia during the period 1830 to 1927 was $17,844,173, or more than one-third of the estimated total output of the Southern Appalachian States.

In 1927 three placer mines produced $1,042 in gold and 7 ounces of silver. The production of gold in 1926 amounted to $3,074. The 1927 output of gold came from small properties at Dahlonega, in Lumpkin County, and from Villa Rica in Douglas County.

The Standard and Liberty Bell mines in Lumpkin County recovered small quantities of gold, mainly by panning. Most of the gold was from the Liberty Bell property of 520 acres, which was operated for about one month. Development was continued at the Turkey Hill free-gold mines. The Saprolite Gold Mining Co. (Inc.) optioned several low-grade saprolite mines near Auraria and was preparing to erect a pilot mill for testing the ores.

Maine, Maryland, New Hampshire, and Vermont.—No production of gold, silver, or copper was reported in 1927 by mines in Maine, Maryland, and New Hampshire. The estimated total gold production of Maryland has been $71,405, virtually all of which was produced prior to 1906.

In 1927 the American Metal Co. worked the old Elizabeth mine at South Strafford, in Orange County, Vt., for several months before abandoning the property. The pyrrhotite ore, which contains a little gold and silver, was mined through a tunnel and an inclined shaft and milled at a 150-ton concentrating flotation plant.

New Jersey (see also p. 3).—The production of zinc ore in New Jersey in 1927 amounted to 629,108 short tons, which contained 191,390,000 pounds of recoverable zinc. All the ore mined was treated by the producer.

New York.—The quantity of zinc ore mined in New York in 1927 was 43,480 short tons, and the concentrates shipped yielded 7,500,000 pounds of zinc.

The St. Joseph Lead Co., which purchased the land and mining property of the New York Zinc Co. in 1926, added new equipment to the 250-ton plant used to treat ore and to the 150-ton mill used for re-treating tailings. The plants are now equipped with gyratory crusher, rod mill, and flotation machines. One 1,300-foot shaft was worked full time and the other part time.

North Carolina.—The value of the gold produced in North Carolina during the period 1799 to 1927 was $23,661,087. The yield of gold decreased from $1,631 in 1926 to $1,015 in 1927. Only a few mines were active, no gold ore was milled, and all the output was from three placer mines. The largest producer of gold in North Carolina in 1927 was the Leeper hydraulic mine near Belmont in Gaston County, owned by Mrs. W. B. Pruett. W. L. Long, of Roanoke Rapids, recovered some gold by sluicing gravel in Nash County. The placer mines in Burke and Rutherford Counties did not report any output.

None of the lode gold mines in Cabarrus, Moore, Davidson, Franklin, or Guilford Counties was worked in 1927 to any extent. It is reported, however, that some of the old properties, including the Rich Cog, Uwarra, and Howie mines, are to be operated in 1928.

The output of copper from North Carolina in 1927 was due to the working of the Fontana mine on Eagle Creek in Swain County by the Fontana Mining Corporation. A narrow-gauge railway connects the mine with the Southern Railway, and the copper ore which is hand-sorted was shipped to the Ducktown Chemical & Iron Co., Isabella, Tenn. The ore is chalcopyrite in mica schist and talc gangue and is hand-sorted before shipment.

Pennsylvania.—The Cornwall iron mines in Lebanon County continued to be worked as open pits by the Bethlehem Steel Co., and yielded 3,466 tons of copper concentrates from pyritiferous magnetite. These concentrates were recovered on Wilfley tables and were shipped to smelters; they contained about 32 per cent of sulphur, 25 per cent of copper, and some gold and silver.

South Carolina.—Mines in South Carolina yielded $5,182,618 in gold during the period 1829 to 1927. No production of gold or silver was reported for 1927.

Tennessee.—The gold produced in Tennessee during the period 1831 to 1927 amounted to $312,196. Most of the output prior to 1879 was derived from placer mines in Monroe County, but the production since 1906 has come entirely from copper ores mined in Polk County. The total value of the mine production of metals in Tennessee decreased $1,277,730 in 1927. There was a small increase in gold, but a decrease in silver, copper, lead, and zinc. The decrease in the quantity and value of both copper and zinc was large, and no lead ore was shipped in 1927.

Mine production of gold, silver, copper, lead, and zinc in Tennessee, 1918–1927

Year	Ore sold or treated	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1918	1,159,971	$4,866	93,620	14,799,680	3,410,400	42,141,311	$7,831,005
1919	1,227,534	5,662	98,288	15,623,589	4,376,000	46,494,000	6,647,723
1920	1,120,995	5,830	110,719	16,727,803	3,957,000	38,434,000	6,634,144
1921	889,122	4,920	98,762	15,084,294		19,384,000	3,018,756
1922	983,844	4,320	78,341	14,240,571	1,464,000	31,136,000	3,860,410
1923	1,355,547	6,615	105,712	18,721,932	2,500,000	31,800,000	5,182,823
1924	1,443,159	6,800	94,779	18,335,635	1,874,000	28,752,000	4,491,070
1925	1,711,298	7,421	102,949	19,788,234	896,000	32,512,000	5,437,660
1926	1,114,400	8,622	104,000	18,606,664	1,600,000	24,196,000	4,621,151
1927	1,152,155	8,816	81,460	14,940,595		20,800,000	3,343,421

The entire output of copper, gold, and silver in Tennessee in 1927 came from two copper mines in the Ducktown district.

The Annette Mines Co. operated the old Coker Creek placer mines in Monroe County, but did not report the recovery or shipment of any bullion in 1927.

The Tennessee Copper Co. ran its 600-ton flotation plant, 1,500-ton blast furnace, Pierce Smith converter, sulphuric acid plant, and copper sulphate plant on sulphide ore from the Burra Burra and Eureka mines. The Polk County and London mines were not worked in 1927. About 6,200 feet of development work was done. The pig copper was shipped to the Nichols Copper Co. for refining.

The Ducktown Chemical & Iron Co. operated one 600-ton blast furnace and one converter on self-fluxing sulphide ore and concentrates from the Mary mine and Isabella mines. The larger part of the crude ore was concentrated at the 600-ton flotation plant. The Mary mine is opened by a 1,200-foot vertical shaft and drifts. The crude copper ore from the Fontana mine in North Carolina was treated at the smelter.

The Ocoee Copper Co. did not operate its mine and concentrating plant in 1927.

The Grasselli Chemical Co. continued to develop its New Market property. Shafts were sunk and drifts run, but no mill has been built.

The Universal Exploration Co. carried on an intensive drilling campaign near New Market. No effort was made to equip the property in 1927. The ore bodies at these nonproductive properties are said to be similar to that at the Mascot mine.

The Embree mine, which had shipped zinc carbonate and lead carbonate ores for many years, was idle in 1927. Some development work was started early in 1928. The zinc carbonate concentrates at this mine average 40.5 per cent zinc content, and the lead carbonate ore and concentrates average 61.8 per cent lead.

Operations at the Mascot mine and mill of the American Zinc Co. of Tennessee, the largest in Tennessee, continued steady. The zinc ore, in dolomitic limestone, was hoisted through two 700-foot shafts and concentrated at a 125-ton per hour plant equipped with oil flotation, ball mills, Cooley jigs, tables, Oliver filter, and Lowden dryer. The crushed tailings are sold for agricultural and other uses. Early in 1928 a lower ore body much richer than any worked heretofore was opened, so that the output of zinc is expected to increase.

Virginia.—The value of the gold produced from mines in Virginia during the period 1828 to 1927 was $3,298,436, of which only about $9,200 was produced during the last 17 years. The lode and the placer gold mines in Albemarle, Floyd, Fauquier, Goochland, and Fluvanna Counties yielded about half of the total gold; the remainder was derived from cinders of pyritic ores or copper ore shipped to smelters.

In 1927 Virginia produced 4,786,000 pounds of lead and 16,650,000 pounds of zinc, having a total value of $1,367,118. A new 750-ton concentrating plant equipped with flotation machines was finished at the Austinville mine, Wythe County. The Ivanhoe Mining & Smelting Corporation continued its exploration of property in the New River district by means of diamond and churn drills; a 250-ton mill is planned.

BAUXITE AND ALUMINUM

By JAMES M. HILL [1]

BAUXITE

DOMESTIC PRODUCTION—IMPORTS AND EXPORTS

In 1927 the bauxite output of the United States was 320,940 long tons, valued at $1,988,780, a decrease of 18 per cent in both quantity and value as compared with 1926. Imports of bauxite aggregated 356,580 long tons, valued at $1,572,236, an increase of 27 per cent in quantity as compared with 1926.

Bauxite produced in the United States, 1923–1927

Year	Georgia, Alabama, and Tennessee [1]		Arkansas		Total	
	Long tons	Value [2]	Long tons	Value [2]	Long tons	Value [2]
1923	28,810	$176,030	493,880	$2,980,580	522,690	$3,156,610
1924	19,940	156,990	327,630	1,981,000	347,570	2,137,990
1925	20,220	109,800	296,320	1,878,450	316,540	1,988,250
1926	20,680	116,650	371,570	2,298,550	392,250	2,415,200
1927	17,110	95,920	303,830	1,892,860	320,940	1,988,780

[1] No production from Alabama in 1924, 1925, and 1926, and none from Tennessee in 1927.
[2] Value f. o. b. mines.

Bauxite imported into and bauxite and bauxite concentrates exported from the United States, 1923–1927

Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value
1923	119,020	$593,882	78,560	$3,380,486
1924	201,974	909,493	77,065	3,979,832
1925	353,696	1,549,120	78,633	4,134,455
1926	281,644	1,187,497	87,770	4,741,260
1927	356,580	1,572,236	121,858	7,800,491

According to a communication to the author bauxite was imported from British and Dutch Guiana during 1927 at an average rate of 27,700 tons per month, as compared with 19,110 tons per month in 1926. Most of it was entered at Gulf ports and was used in the aluminum industry. A few cargoes of South American bauxite were shipped to north Atlantic ports and were consumed by the chemical industries. Some South American bauxite was shipped direct to Canada. Owing to the large size, high quality, and ease of exploitation of the deposits in these countries their bauxite has replaced the domestic bauxite except that from deposits where the conditions for exploitation are exceptionally favorable.

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[1] Helen M. Gaylord, of the Bureau of Mines, assisted in the preparation of this report. Figures on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey of the Bureau of Mines.

Some alumina obtained several years ago as a by-product in the treatment of alunite for its potash content at Marysvale, Utah, was sold in 1927 for use in refractories.

Domestic bauxite was reported as sold to five consuming industries in 1927, as shown in the table that follows. Sales of domestic bauxite to the aluminum industry decreased 23 per cent, those to the manufacturers of aluminum salts 20 per cent, and to makers of artificial abrasives 1 per cent, as compared with 1926.

Domestic bauxite sold by producers to industries in the United States, 1923–1927, in long tons

Industry	1923	1924	1925	1926	1927
Aluminum	380, 520	225, 780	173, 040	241, 850	186, 490
Chemical	68, 870	54, 870	67, 420	77, 960	62, 410
Abrasive [1]	72, 830	66, 400	73, 720	72, 210	71, 790
Refractory	470	440	260	230	160
Alumina cement	------------	80	------------	------------	90

[1] Includes alumina used for refractories.

For a number of years it has been impossible to give separate statistics showing the output of either artificial aluminous abrasives or refractories. Some measure of the combined output of these materials made from bauxite may be had from the quantity of bauxite sold to manufacturers, as indicated in the preceding table. Figures for aluminous abrasives heretofore reported in the chapters on bauxite and aluminum and abrasives in Mineral Resources have included annually increasing quantities of aluminum oxide used as refractory material.

Value of aluminum and aluminum salts made from bauxite, 1923–1927

Year	New aluminum	Aluminum salts
1923	$28, 305, 000	$8, 987, 400
1924	37, 607, 000	9, 301, 400
1925	36, 430, 000	13, 155, 790
1926	37, 583, 000	13, 202, 010
1927	39, 266, 000	14, 288, 430

TOTAL BAUXITE PRODUCTION OF THE UNITED STATES

The first bauxite produced in the United States was obtained in 1889 from deposits in the north Georgia field, and in 1891 bauxite was first produced from the Alabama deposits. Practically all the bauxite mined in the United States until 1899 came from these two States. In 1896 the first shipments were made from Arkansas deposits, but it was not until 1900 that their influence was felt. In

1907 bauxite from the Tennessee deposits was first shipped. The total production of bauxite recorded in Mineral Resources from 1889 to 1927, inclusive, is 6,758,584 long tons.

MARKET AND PRICES

Bauxite finds its market east of Mississippi River and is sold largely to the manufacturers of aluminum, abrasives, commercial chemicals, and refractories. The manufacturers of alumina cements are largely supplied by imported bauxite. High-alumina (diaspore) clays produced in Missouri are now used in the manufacture of refractories and are sold according to their alumina content; three grades containing 55, 65, and 70 per cent of alumina (Al_2O_3) are regularly handled. Information on production will be found in the Mineral Resources report on clay.

Some of the makers of refractories and of aluminum chemicals are using increasing quantities of clay as a crude material in place of bauxite.

BAUXITE PRODUCERS IN THE UNITED STATES IN 1927

American Bauxite Co., Bauxite, Ark.
Wm. J. Crouch Mining Co., Adairsville, Ga.
Globe Bauxite Co., Joliet, Ill.
Hill, D. B., Sweet Home, Ark.
Kalbfleisch Corporation, 200 Fifth Avenue, New York, N. Y.
Charles Lennig & Co. (Inc.), 222 West Washington Square, Philadelphia, Pa.
Republic Mining & Manufacturing Co., 1111 Harrison Building, Philadelphia, Pa.
Superior Bauxite Co., Joliet, Ill.

The largest consumers of bauxite in the United States are also producers, and only a small market exists for what might be called "outside bauxite." Consumers who do not own deposits contract for their supplies for considerable periods, apparently to assure an adequate supply of bauxite of the grade desired. The price of bauxite at mines or shipping points in 1927, as reported by independent producers, ranged from $5 to $6.50 a ton; the average price reported by all producers for the year was $6.20 a ton f. o. b. mines. Consumers, on the other hand, report prices that average $12.42 a ton f. o. b. plants. The price at consuming plant varies with the distance from mines, and transportation charges are a large element of cost. The highest consumer's price was $18.25 a ton at California plants. The average for Mississippi Valley consumers was about $12.50 a ton for domestic bauxite. Seaboard plants consumed considerable foreign bauxite, which cost on the average $14.75 a ton f. o. b. consumer's plant.

CONSUMERS OF BAUXITE IN THE UNITED STATES IN 1927

Aluminum Ore Co., East St. Louis, Ill.
Atlas Portland Cement Co., 25 Broadway, New York, N. Y.
Calumet Chemical Co., Joliet, Ill.
The Carborundum Co., Niagara Falls, N. Y.
Charles Lennig & Co. (Inc.), 222 West Washington Square, Philadelphia, Pa.
Como Chemical Co., Kokomo, Ind.
E. I. du Pont de Nemours & Co., Wilmington, Del.
Exolon Co., 156 Sixth Street, Cambridge, Mass.

General Abrasive Co. (Inc.), Niagara Falls, N. Y.
General Chemical Co., 40 Rector Street, New York, N. Y.
General Refractories Co., Trinity Building, New York, N. Y.
Gulf Refining Co., Frick Building Annex, Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Jarecki Chemical Co., St. Bernard Station, Cincinnati, Ohio.
Kalbfleisch Corporation, 200 Fifth Avenue, New York, N. Y.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Merrimac Chemical Co., 148 State Street, Boston, Mass.
Metropolitan Utilities District, Omaha, Nebr.
The Newport Co., Carrollville, Wis.
North Hudson Chemical Co. (Inc.), Albany, N. Y.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
Passaic Cons. Water Co., 158 Ellison Street, Paterson, N. J.
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Sacramento Filtration Works, Sacramento, Calif.
Stauffer Chemical Co., 624 California Street, San Francisco, Calif.
Superior Chemical Co., Joliet, Ill.
Water Department of Kansas City, Kansas City, Mo.
Water Softening and Purification Works, Columbus, Ohio.
Welch Chemical Co., 8 East Long Street, Columbus, Ohio.

The price of bauxite is regularly quoted in the Engineering and Mining Journal. "No. 1 chemical ore, over 60 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 2 per cent Fe_2O_3," was quoted at $8 a ton f. o. b. Georgia mines all the year. Dalmatian low-silica bauxite was quoted at $5 to $6.50 a metric ton c. i. f. Atlantic ports; Istrian, $5.50 to $7; and French red bauxite, $6 to $7.50.

Under the tariff act of 1922 crude bauxite is dutiable at the rate of $1 a ton, and alumina hydrate or refined bauxite at one-half cent a pound. (See par. 6, Schedule 1, and par. 207, Schedule 2.)

BENEFICIATION OF BAUXITE

The Southern Experiment Station of the United States Bureau of Mines (Birmingham-Tuscaloosa, Ala.) is making an investigation of the beneficiation of low-grade, high-silica, and high-iron bauxites. Flotation tests using sodium sulphide and oleic acid on material crushed in such manner as to produce little slime seem to be promising.

Hyde [2] has recently patented a process for dehydrating bauxite by crushing, mixing with coal or coke and iron oxide or other material that will form aluminates, and heating on grates to 1,200° C. By this process he claims that a porous cake, impervious to water, is produced, which will handle and store much better than dried or calcined bauxite and which is more readily used in further metallurgical steps than is the crushed product.

Tilley, Millar, and Ralston [3] review the various processes heretofore used for the manufacture of alumina from various raw materials, discuss the economics of the problem, and give details of a method devised during the course of their investigations for the preparation of pure alumina.

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[2] Hyde, R. W., United States Patent 1655608, Jan. 10, 1928.

[3] Tilley, G. S., Millar, R. W., and Ralston, O. C., Acid Processes for the Extraction of Alumina: Bull. 267, Bureau of Mines, 1927, 85 pp.

WORLD'S PRODUCTION

World's production of bauxite, 1923–1927, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923	1924	1925	1926	1927
Australia: Victoria	------	------	------	------	936
Austria	2, 734	------	------	------	(1)
British Guiana [2]	101, 957	156, 800	177, 808	189, 101	163, 454
Bulgaria	(1)	796	(1)	(1)	(1)
France	393, 736	388, 692	505, 189	408, 600	540, 000
Germany	6, 664	3, 085	1, 767	------	2, 400
Greece	(1)	1, 300	3, 700	2, 320	1, 300
Hungary	500	192	390	3, 666	(1)
India, British	6, 652	23, 601	10, 232	5, 036	(1)
Ireland, Northern	3, 504	5, 241	5, 121	(1)	5, 394
Italy	98, 055	140, 790	195, 000	90, 500	95, 300
Rumania	4, 162	------	------	745	1, 706
Surinam (Dutch Guiana)	15, 839	63, 097	86, 277	44, 230	180, 691
United States	531, 079	353, 148	321, 620	398, 546	326, 091
Yugoslavia	32, 631	18, 485	79, 032	131, 828	100, 327

[1] Data not available. [2] Exports.

BAUXITE DEPOSITS

GENERAL

Fox[4] has brought together a mass of information on laterite deposits of the world, particularly the bauxitic type. He classifies laterite under three headings: (1) Alteration of rock in situ, characterized by a high percentage of combined water varying from 19 to 32 per cent; (2) due to deposition, seldom contains less than 8 or more than 14 per cent combined water; (3) detrital or redeposited laterite, frequently characterized by rounded grains of quartz and other, evidently derived, substances.

Harrassowitz[5] has published a study of lateritic deposits of the world, including a complete chemical study of laterite.

Thiel[6] has shown by a series of experiments that sulphate-reducing bacteria, such as are commonly present in residual soils, aid through biochemical reaction in the solution of alumina. He believes that they may have an important rôle in the formation of lateritic bauxite deposits.

UNITED STATES

Adams,[7] after summarizing the literature on the occurrences of bauxite in the Tennessee-Georgia-Alabama field, concludes that they are all approximately of the same age, Eocene, and "were formed under peculiar physiographic and climatic conditions," which, he implies, are those postulated for the lateritic alteration of rocks.

The bauxite deposits of the United States are in central Arkansas, northeastern and east-central Alabama, northwestern and west-central Georgia, northeastern Mississippi, and eastern Tennessee.

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[4] Fox, Cyril S., Bauxite: London, 1927, 312 pp.

[5] Harrassowitz, Herman, Laterite Material und Versuch erdgeschichtlicher Auswertung: Berlin, 1926. Reviewed by R. J. Leonard in Econ. Geol., vol. 22, No. 5, August, 1927, pp. 530–531.

[6] Thiel, G. A., "The enrichment of bauxite deposits through the activity of micro-organisms": Econ. Geol., vol. 22, No. 5, August, 1927, pp. 480–493.

[7] Adams, G. I., "Bauxite deposits of the Southern States": Econ. Geol., vol. 22, No. 6, September-October, 1927, pp. 615–620.

The bauxite from all localities in the United States, though it may differ in chemical composition, is on the whole similar in general appearance, with the exception of the "granitic bauxite" of the Arkansas field. The greater part of the American bauxite appears to be made up of rounded pebblelike bodies set in a fine-grained matrix, which may also consist of small rounded particles or may be as fine-grained as the finest clay. The pebble or pisolite form is so general that it is the conspicuous characteristic of American bauxite.

There is only one way to determine the value of bauxite, and that is by chemical analysis, which should show total silica, alumina, titanium oxide, iron oxide, and water. Bauxites of commercial grade should carry at least 52 per cent of alumina.

Some measure of the relative quality of dried bauxite can be had by grinding a sample in an agate mortar for half a minute (J. M. Hill test). A bauxite of good grade will be found hard to grind and will stick to the mortar with such tenacity that it will have to be scoured out; a poor bauxite or bauxitic clay will grind much more easily and will stick very little, if at all; and clay or kaolin grinds with ease and does not stick to the mortar. Similar results are found if the sample is rubbed with considerable pressure on glass; the glass will not be scratched, but the material of highest alumina content will stick the hardest.

Alabama.—Bauxite was produced in Alabama in 1927 from three deposits in the Eufaula district in Barbour County, the area between Fort Gaines, Ga., and Clayton, Ala. The total output of the State was 4,060 long tons, valued at $24,690. Practically all the bauxite was dried and shipped to makers of chemicals.

Arkansas.—Five operators in Arkansas produced 303,830 long tons of bauxite in 1927, a decrease of 18 per cent as compared with the production in 1926. The deposits in Saline County contributed 92 per cent of the output of the State in 1927, as compared with 89 per cent in 1926. The producers of the State were the American Bauxite Co., Globe Bauxite Co., D. B. Hill, Republic Mining & Manufacturing Co., and Superior Bauxite Co. Sixty per cent of the bauxite produced in Arkansas in 1927 was consumed by the aluminum industry, 24 per cent by the abrasive industry, and 16 per cent by the chemical industry.

Georgia.—Two operators produced bauxite from three counties in Georgia in 1927. The total output was more than 13,050 long tons, a decrease of 34 per cent as compared with 1926. The largest producer was the Republic Mining & Manufacturing Co., which worked deposits near Irwinton, Wilkinson County, and Vans Valley and Hermitage, Floyd County. The Kalbfleisch Corporation operated mines in Macon County near Oglethorpe.

Mississippi.—No shipments of bauxite were made from the deposits in northeastern Mississippi, which were discovered by J. W. Adams in 1921.

Tennessee.—The bauxite properties in the vicinity of Chattanooga were not productive in 1927.

Utah.—About 1,200 tons of by-product alumina from Marysvale was shipped for use in the manufacture of high-grade aluminous refractories in 1927.

FOREIGN COUNTRIES

Africa.—Consul Claiborne[8] at Frankfort on the Main reported that much interest was shown by the Germans in a newly discovered bauxite area in the Atlas Mountains in French Morocco. It is stated that 20,000,000 tons can be mined from the top layers and that the grade is exceptionally high—that is, 70 per cent alumina.

British Guiana.—Emory[9] gave an interesting talk at the February meeting of the New York section of the American Institute of Mining and Metallurgical Engineers and described particularly the bauxite deposits in the Demerara River valley. He classified the bauxite deposits under three heads: (1) Weathered pegmatite dikes, small and of little economic importance; (2) lenses of massive bauxite in the sand-clay belt of the coastal plain, most important at present; and (3) lateritic deposits at the edge of the hinterland, not much known as yet.

Meehan,[10] in an article covering the economic situation in the Guianas, says, "The first year of steady operation (of bauxite deposits) in British Guiana was 1923; * * * since that year it (production) has averaged 171,066 tons."

Export duties on bauxite and its derivatives from British Guiana were revised under a law effective March 1, 1927.[11] The old duty of 1½ per cent ad valorem was changed to $0.18 a ton (presumably the long ton is meant).

Mitchiner[12] has given a popular account of the difficulties of prospecting in tropical South America and some notes on the geology and geography of British Guiana.

Conolly,[13] a government geologist, has given an interesting account of the diamond fields and considerable information about the geology of British Guiana lying south and west of the present producing bauxite areas.

Dutch Guiana.—Kilinski,[14] in a general paper on the geology of Dutch Guiana, says, "The bauxite deposits are extensive and accessible, but all deposits, if not held outright by the Aluminum Co. of America are controlled. There are extensive areas still to be prospected for bauxite and the chances of finding it are favorable."

The Guiana Mining & Development Co., also known as the Wolf Syndicate, was granted a concession to two mineral areas in Dutch Guiana, covering 100,000 acres.[15] According to a communication to the author, bauxite, which was used in the manufacture of aluminum chemicals, was produced by the Kalbfleisch Corporation of New York from deposits 20 miles south of Paramaribo on the Surinam River.

Meehan[16] says of the Dutch Guiana bauxite operations that work was started in 1917 but was suspended from 1920 to 1922 because of the state of the metal market. The production in 1926 was about

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[8] Claiborne, Hamilton C., Commerce Reports, Mar. 26, 1928, pp. 817-818.

[9] Emory, L. T., "British Guiana bauxite deposits": Min. and Met., vol. 9, January, 1928, pp. 8-11.

[10] Meehan, M. J., "Economic development of the Guianas": Commerce Reports, Oct. 17, 1927, pp. 136-137.

[11] Commerce Reports, May 9, 1927, p. 376.

[12] Mitchiner, J. H., "The alluvial diamonds of British Guiana": Min. Mag. (London), vol. 36, No. 2, February, 1927, pp. 73-83.

[13] Conolly, H. J. C., "The Mazaruni and Puruni diamond fields, British Guiana": Min. Mag. (London), vol. 36, No. 3, March, 1927, pp. 137-149.

[14] Kilinski, E. A., "Notes on Dutch Guiana": Min. and Met., vol. 9, February, 1928, pp. 59-61.

[15] Engineering and Mining Journal: Vol. 125, No. 5, Feb. 4, 1928, p. 216.

[16] Meehan, M. J., "Economic development of the Guianas": Commerce Reports, Oct. 17, 1927, pp. 136-137.

44,000 metric tons and in 1927 was 181,000 tons, all of which was sent to the United States.

France.—Production of bauxite in France in 1927 was 540,000 metric tons[17] as compared with 408,600 tons in 1926. The Société des Carrières de l'Arboussas, 63 Avenue des Champs Elysées, Paris, has been formed with a capitalization of 500,000 francs to exploit bauxite deposits near Arboussas, southeast of Bédarieux in Hérault Province. The deposits are in the form of large pockets on the flanks of hills, which permit open-cut mining. The bauxite is red, rich in alumina, and low in silica.[18]

Germany.—That Germany has little bauxite she cares to use, except under the spur of necessity, is clearly shown by her interest in the development of the Hungarian deposits, from which there was a large production in 1927. Formerly most of the bauxite used in Germany was imported from Istria and France, but beginning in January, 1927, a large part of the bauxite used by the German aluminum industry came from Hungary, as follows:[19] January, 5,307 tons; March, 16,410 tons; April, 13,971 tons.

In 1927 Germany imported 540,000[20] tons of bauxite as compared with 237,000 tons in 1926.

German imports of bauxite, 1926–27, in metric tons

Source	1926	1927
France	113, 800	153, 400
Hungary		235, 500
Italy	89, 700	70, 200
Yugoslavia	27, 500	72, 900
Other sources	6, 000	8, 000

Hungary.—Vice Consul Morgan,[21] of Budapest, states that the bauxite reserves in the Northern Vértes Mountains and in the Bakony Mountains on Lake Balaton are estimated at 200,000,000 metric tons. Exploitation in the Vértes Mountains was begun near the village of Gant in the county of Fejér, which produced 1,200 to 1,400 tons a day. The estimated output in 1927 was 250,000 to 300,000 tons, most of which went to Germany. Prices ranged from 12 to 20 English shillings a ton f. o. b. Bodajk. The Aluminum Ore Mining & Industrial Co. and the Tapolca Mining Co. (Ltd.), both of Budapest, are the only producers. The former company, organized in 1917 to exploit Rumanian bauxite, was merged in 1923 with Rumanian and Italian companies to form the Bauxite Trust A. G., capitalized at 3,000,000 Swiss francs. The Tapolca Mining Co. (Ltd.) is controlled by the Bauxite Trust A. G. through the Aluminum Ore Mining & Industrial Co. Its mines were not productive up to the time of uniting, the consul reported. Plans are under consideration for the manufacture of aluminum in Hungary. Plants, with a capacity of 100,000 tons, for the manufacture of high-alumina cement are under construction and should be producing early in 1928.

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[17] Annales des Mines, Series 12, vol. 13, No. 3, p. 194.
[18] Journal du four électrique, 37th year, No. 2, February, 1928, p. 41.
[19] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, No. 147, June 25, 1927, p. 1.
[20] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, No. 181, Mar. 3, 1928.
[21] Morgan, J. H., "The Hungarian bauxite industry": Commerce Reports, July 18, 1927, pp. 164–165.

The report[22] that the Aluminum Co. of America had purchased an interest in the Bauxite Trust A. G. was denied by company officials in a communication to the author.

India.—The production of bauxite in 1926 was 4,956 long tons, as compared with 10,070 tons in 1925.[23]

Poland.—It is reported[24] that a newly found deposit of bauxite will be worked by a company, capitalized at 15,000,000 zlotys, which will make 2,400 tons of aluminum a year.

Yugoslavia.—It is reported that a Franco-Belgian company will exploit bauxite deposits at Dernis, Dalmatia, and that deposits near Nicksic and Risany in Montenegro will be operated by an American group.[25]

ALUMINUM

DOMESTIC PRODUCTION—IMPORTS AND EXPORTS

The value of the new aluminum produced in the United States in 1927, $39,266,000, was 4 per cent greater than that of 1926, and the value of the secondary aluminum, $23,469,600, was 2 per cent less than in 1926.

According to statistics collected by J. P. Dunlop, of the Bureau of Mines, secondary aluminum was recovered to the amount of 23,000 short tons as metal and 23,200 short tons as the aluminum content of casting alloys. The total recovery was 46,200 short tons.

Value of aluminum produced in, imported into, and exported from the United States, 1918–1927

Year	Domestic production		Imports [b]	Exports [c]
	Primary metal	Secondary metal [a]		
1918	$41, 159, 000	$10, 113, 600	$554, 586	$10, 869, 388
1919	38, 558, 000	12, 014, 600	4, 568, 595	3, 890, 326
1920	41, 375, 000	9, 489, 100	13, 077, 022	5, 630, 781
1921	10, 906, 000	3, 775, 400	8, 889, 791	3, 108, 857
1922	13, 622, 000	6, 085, 900	9, 695, 012	2, 836, 116
1923	28, 305, 000	10, 824, 600	8, 742, 563	3, 571, 539
1924	37, 607, 000	14, 596, 200	7, 145, 036	4, 172, 390
1925	36, 430, 000	24, 816, 000	10, 106, 767	6, 057, 071
1926	37, 583, 000	23, 868, 000	16, 779, 377	4, 452, 303
1927	39, 266, 000	23, 469, 600	14, 201, 978	6, 307, 421

[a] Value of secondary aluminum based on average price at New York as given by American Metal Market.

[b] Imports for consumption include aluminum in crude form, scrap, bars, strips, rods, plates, sheets, and all manufactures of aluminum.

[c] Exports include ingots, metal and alloy, plates and sheets, and all manufactures of aluminum.

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[22] Engineering and Mining Journal: Vol. 124, No. 9, Aug. 27, 1927, p. 345.

[23] Records of the Geological Survey of India: Vol. 60, pt. 3, 1927, p. 241. Calcutta.

[24] Engineering and Mining Journal: Vol. 125, No. 3, Jan. 21, 1928, p. 136.

[25] Journal du four électrique, 37th year, No. 3, March, 1928, p. 77.

Aluminum imported for consumption in the United States, 1926–27, by classes

Class	1926		1927	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Crude form, scrap, alloy, etc	71, 277, 690	$16, 384, 633	62, 246, 665	$13, 237, 803
Plates, sheets, bars, strips, rods, coils, and blanks	112, 939	36, 974	328, 557	79, 183
Circles, disks, rectangles, and squares	1, 088	298		
	71, 391, 717	16, 421, 905	62, 575, 222	13, 316, 986
Manufactures:				
Leaf (5½ by 5½ inches)	(1)	42, 530	(1)	28, 648
Powder, powdered foil	72, 306	34, 388	116, 101	45, 927
Foil less than 0.006 inch thick	185, 478	108, 064	1, 094, 791	627, 918
Table, kitchen, and hospital utensils and other similar hollow ware	204, 682	96, 621	137, 419	72, 163
All other manufactures	(2)	75, 869	(2)	110, 336
		357, 472		884, 992
Grand total		16, 779, 377		14, 201, 978

[1] 1926: 28,520,325 leaves; 1927: 18,967,042 leaves; equivalent in pounds not recorded.
[2] Quantity not recorded.

Exports of ingots, scrap, and alloys in 1927 were six times those of 1926, and exports of plates, sheets, bars, strips, and rods increased 56 per cent. The value of tubes, moldings, etc., exported declined 26 per cent, but the value of the table, kitchen, and hospital utensils increased 7 per cent. Exports of other manufactured goods increased 58 per cent in value as compared with 1926.

Domestic aluminum exported from the United States, 1926–27, by classes

Class	1926		1927	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Ingots, scrap, and alloys	586, 749	$137, 980	3, 525, 085	$741, 954
Plates, sheets, bars, strips, and rods	7, 047, 422	1, 997, 107	10, 997, 475	2, 736, 695
	7, 634, 171	2, 135, 087	14, 522, 560	3, 478, 649
Manufactures:				
Tubes, moldings, castings, and other shapes	2, 115, 274	671, 859	1, 529, 615	499, 767
Table, kitchen, and hospital utensils	(1)	530, 563	(1)	565, 443
Other manufactures of aluminum	(1)	1, 114, 794	(1)	1, 763, 562
	(1)	2, 317, 216	(1)	2, 828, 772
Grand total	(1)	4, 452, 303	(1)	6, 307, 421

[1] Quantity not recorded for table, kitchen, and hospital utensils and other manufactures.

MARKET AND PRICES

Quotations on virgin aluminum, as given by the Engineering and Mining Journal, began the year 1927 at 27 cents a pound for the 99 per cent grade but on January 15 were lowered to 26 cents; on October 20 the quoted price was reduced to 25 cents a pound, the average for the year being $0.2584 a pound. Foreign and secondary aluminum was sold at 2 to 7 cents a pound below the domestic figures for similar grades, the average for the year being $0.254.

The Aluminum Co. of America reported that the demand for the metal in 1927 was not as great as in 1926. The important dams, one in the Yadkin River and one in Little Tennessee River, in North Carolina, which will equalize the stream flow to the hydroelectric plants and thus obviate such a condition as the Alco and Badin aluminum works suffered in 1925, were completed in 1927. The severe reduction in automobile production in 1927, when only 3,391,887 passenger cars and trucks were produced, as compared with 4,298,799 in 1926,[26] was keenly felt by the Aluminum Co. of America, whose income in 1927 was $13,671,940, as compared with $19,747,068 in 1926. Sales in 1926 were greater than production, but in 1927, with an output one-third larger than in 1926, the sales were so much under the output that large stocks of metal were in the warehouses of the company at the end of 1927.[27]

In spite of curtailed production of automobiles the use of aluminum and high-strength aluminum alloys was large, particularly for pistons and reciprocating parts of automotive engines. Aluminum powder for paint pigment was more extensively used, and the use of aluminum foil increased materially. The use of aluminum for collapsible tubes for pastes, greases, etc., although relatively new, is growing. Aluminum shingles and corrugated sheet for roofing and siding, which were introduced recently, were more widely used during 1927. More aluminum was used in the manufacture of furniture, airplanes, railroad and street cars, and motor busses than in 1926.

One of the most important advances [28] in the aluminum industry during 1927 was the introduction of "Alclad." This is a strong aluminum alloy, heat-treated, with a surface coating of pure aluminum. It is extremely light, has great strength, and is resistant to corrosion. It is particularly valuable to the aircraft industry. A development during 1927, with a potential market for 10,000,000 pounds of aluminum, is in the manufacture of mason jar caps, which are said to have been well received. Makers of transportation equipment for railroads or street railway lines, bus manufacturers, and aircraft makers have shown increased interest in and consumption of the new high-strength aluminum alloys because of the great saving in weight with no sacrifice of strength possible by the use of the newer heat-treated alloys.

One who is closely conversant with the aluminum industry and calls himself "Aluminum Man,"[29] has begun a series of articles sketching the history of aluminum and its method of preparation, and giving considerable detail of the newer developments and uses of the metal and alloys.

Experiments by the German Aluminum Research Institute indicate that specially treated aluminum sheet can be used as a substitute for tinned sheet for the manufacture of containers for vegetables, fruit, etc.[30]

Anderson [31] reviews the aluminum industry during 1927, and does not look with alarm at the future. However, many students of the situation look for hard times in the aluminum industry because of the great expansion of producing capacity, either under way or planned. Anderson estimates the world production of aluminum for 1927 as follows:

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[26] Commerce Reports, Jan. 13, 1928, p. 431.

[27] Metal Industry, "Annual Report of Aluminum Co. of America": Vol. 26, No. 3, March, 1928, p. 141.

[28] Metal Industry, "Aluminum in 1927": Vol. 26, January, 1928, p. 21

[29] Metal Industry, "The development of the aluminum industry": Vol. 26, No. 3, March, 1928, pp. 114-115; vol. 26, No. 4, April, 1928, pp. 157-158.

[30] Metal Industry, vol. 25, No. 10, October, 1927, p. 416.

[31] Anderson, R. J., "Aluminum production and trade well maintained in uneven industrial year": Am. Metal Market, Magazine Section, Jan. 21, 1928, p. 6.

	Pounds
United States	160, 000, 000
Germany	70, 000, 000
Canada	60, 000, 000
Norway	46, 000, 000
France	44, 000, 000
Switzerland	44, 000, 000
United Kingdom	16, 000, 000
Austria	6, 000, 000
Italy	4, 000, 000
	450, 000, 000

The aluminum situation in Europe during 1926 is well summarized editorially by the Journal du four électrique in volume 36, No. 14, for October 15, 1927. European production in 1926 reached 106,700 tons and that of the world 200,000 tons, but even this large output was not enough to meet the demand and large installations were nearing completion in Italy and Spain. The consumption of aluminum in Europe was 73,400 tons in 1926. The excess European production, however, was absorbed by the United States. The European price of aluminum during 1926 was lowered from £120 to £115, and then to £107 a ton; the price in France at the end of the year was 13 francs 30 the kilo (five times greater than the price before the war of 2 francs 60 the kilo). The European Aluminum Cartel states that the consumption during the first six months of 1927 was 10 per cent greater than in the same period of 1926 and 30 per cent greater than in the first six months of 1925. New bauxite deposits have been discovered and material carrying as low as 52 per cent Al_2O_3 and 7 per cent SiO_2 is now used. There is every possibility that minerals carrying only 35 per cent Al_2O_3 will be consumed in the manufacture of the metal. Aluminum makers know that it takes much time and money to build new plants and feel that the increased consumption, due to development of old outlets and new uses, indicates a further expansion of producing capacity as necessary. In France the production of aluminum has reached 25,000 tons a year and will be increased during 1927 by the addition of 6,000 tons in new capacity.

METALLURGY OF ALUMINUM

Haglund,[32] the inventor of the Haglund process, has given detailed information concerning his process. Plant construction costs are much lower using this process than costs for a plant manufacturing alumina chemically. One great advantage of the process is that high iron and silica bauxites can be used to produce pure alumina, and a salable high-silica pig iron by-product is made. The process is essentially one of reduction of the impurities by carbon. The alumina slag contains 15 to 25 per cent of a sulphide, preferably aluminum, which dissolves alumina at the temperature at which the furnace is operated. The slag containing alumina and aluminum sulphide is very fluid and separates easily from the iron alloy. When cooled the alumina crystallizes and may be separated from the crushed slag by a simple water treatment. The raw materials are bauxite, carbon (coke or charcoal), and some iron sulphide such as pyrite or pyrrhotite.

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[32] Haglund, T. R., "The Haglund process for the electrothermic production of pure aluminium oxide": Ind. and Eng. Chem., vol. 18, January, 1926, p. 67. Reviewed in Eng. and Min. Jour., vol. 122, No. 14, Oct. 2, 1926, p. 530.

From such information as is available, the Pedersen process [33] controlled by the Norsk Aluminum Co., which is building a plant at Honagar to operate on this plan, is quite similar to the Haglund.

On December 12, 1927, the United States Bureau of Standards issued Circular 346, entitled "Light Metals and Alloys—Aluminum, Magnesium," a revision of its previous reports. This volume of 403 pages brings together in systematic form available data on the properties, statistics, and manufacture of the light metals and alloys. It contains a bibliography of 73 pages, so arranged that papers on every phase of the subjects covered can be readily found.

At the February, 1928, meeting of the American Institute of Mining and Metallurgical Engineers the Institute of Metals Division gave considerable space on its program to papers on aluminum. These technical publications are listed below.

No. 23, Class E, Institute of Metals, No. 5: Heat treatment of aluminum-silicon alloys, by R. S. Archer, L. W. Kempf, and D. B. Hobbs.

No. 30, Class E, Institute of Metals, No. 9: Equilibrium relations in aluminum-silicon and aluminum-iron-silicon alloys of high purity, by E. H. Dix and A. C. Heath, jr.

No. 31, Class E, Institute of Metals, No. 10: Machining aluminum, by R. L. Templin.

No. 32, Class E, Institute of Metals, No. 11: Some aspects of the commercial manipulation of aluminum, by C. F. Nagel, jr.

No. 33, Class E, Institute of Metals, No. 12: Commercial forms and applications of aluminum and aluminum alloys, by P. V. Faragher.

No. 91, Class E, Institute of Metals, No. 34: Aluminum-beryllium alloys, by R. S. Archer and W. L. Fink.

FOREIGN ALUMINUM INDUSTRY

Canada.—The first unit of the Arvida plant of the Aluminum Co. of America was in full operation throughout 1927. Alumina for this plant is now coming from the United States. McBride [34] describes the plant, where provision is made for the manufacture of electrodes, the pots, and pot lining, in much detail. There are 40 furnace rooms at Arvida, each of which has 100 pots, connected in series on a 6-volt line. McBride states that, while the theoretical consumption of carbon is two-thirds pound per pound of aluminum produced, in practice three-fourths to one pound of carbon is consumed. The theoretical power consumption is 5 kilowatt-hours a pound of metal but in practice consumption is 12.5 to 13 kilowatt-hours.

England.—The annual report [35] of the British Aluminum Co. for 1926 indicates that the coal strike interfered materially with its production and earnings, which were further curtailed by the lowering of metal prices near the close of the year. The company's sales of metal for power-transmission cables doubled those for 1925. The plant at Burntisland was enlarged and the Lochaber power project is progressing well. The company paid a 10 per cent dividend.

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[33] Engineering and Mining Journal, "Europe uses new processes for recovery of aluminum": Vol. 124, No. 17, Oct. 22, 1927, p. 647.

[34] McBride, R. S., "Modern technology in producing pig aluminum": Chem. and Met. Eng., vol. 34, No. 2, February, 1927, pp. 76-83.

[35] Journal du four électrique, 36th year, No. 7, May, 1927, p. 101.

Exports of crude aluminum from England in 1927 were 10,189 tons, most of which went to India and the Orient.[36]

France.—The production of aluminum in France in 1927 was 25,500 metric tons as compared with 24,000 tons in 1926. Exports of aluminum ingots in 1927 were 6,098 metric tons, 867 tons in 1926, and 2,137 tons in 1925.[37]

France also exported 28,233 tons of alumina in 1927 as compared with 21,640 tons in 1926.

Hydroelectric development in France since the war has been rapid, but of the estimated possible power of 5,098,000 kilowatts only some 783,000 are developed, of which 100,000 kilowatts is from small plants of less than 1,000-kilowatt capacity. Future development is under the control of the Minister of Public Works, and an official plan for such development has been worked out, according to Commercial Attaché Jones.[38]

Germany.—The annual report[39] of the Vereinigte Aluminum Werke A. G. for 1926 states that its Innwerk plant at Toeging in Upper Bavaria was producing at a normal rate, using coal-generated power. Production of electrodes at the Erftwerk plant at Grevenbroich increased and the output of aluminum at this plant was 6,000 tons in 1926. The company took over the use of the Haglund process for making alumina and proposed to install the necessary plant.

Based on available power it is estimated that the German aluminum industry could produce 43,000 tons of metal a year, provided suitable raw materials were available.[40] However, the plants operating in 1927 had a total capacity of only about 30,000 tons.

Consumption of aluminum in Germany in 1927 was large. Imports were about 11,000 metric tons, as compared with 5,527 tons in 1926, while exports in 1927 were about 5,500 tons, as compared with 12,474 tons in 1926.[41]

A combination of the four largest manufacturers of aluminum alloys in Germany, known as the Vereinigte Leichtmetall-Werke of Bonn, was perfected during 1927. It will virtually control the production of aluminum alloys in all forms and will conduct research on new uses of the metal.[42]

Italy.—Development of the aluminum industry in Italy has been rapid, and it is reported[43] that, with the completion of the Sila reservoir in Calabria and other projects, Italian capacity will be raised to between 15,000 and 16,000 metric tons a year. The plants will be as follows:

Società Montecatini at Cotrone Maia.
Società Alluminio Veneta at Porto Marghera.
Società Italiana Alluminio at Borgofranco.
Società Mermoude Frères at Trent.
Società Chimica at Naples.
Società di Elettrochimica at Bussi.

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[36] Journal du four électrique, 37th year, No. 2, February, 1928, p. 41.

[37] Journal du four électrique, 37th year, No. 3, March, 1928, p. 69.

[38] Jones, C. L., "Status and prospects of hydraulic developments in France": Commerce Reports, Apr. 25, 1927, pp. 223-224.

[39] Journal du four électrique, 36th year, No. 7, May, 1927, p. 100.

[40] Engineering and Mining Journal, "Germany well equipped to produce aluminum": Vol. 123, No. 5, Jan. 29, 1927, pp. 210-212.

[41] Anderson, R. J., "Aluminum production and trade well maintained in uneven industrial year" Am. Metal Market, Magazine Section, Jan. 21, 1928, p. 6.

[42] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, No. 151, July 23, 1927.

[43] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, No. 171, Dec. 10, 1927.

The production of aluminum in Italy in 1927 was 2,300 tons as compared with 1,929 tons in 1926. The Società Italiana dell' Alluminio was formed with a capital of 80,000,000 lire to put in hydroelectric works at Mori in Rovereto Province. German capital, associated with the Lautawerk, is interested.[44]

The Società Elettrochimica, with a capital of 42,000,000 lire, was absorbed by the Società Meridionale di Elettrecità and the new company is capitalized at 75,000,000 lire.[45]

The Società Italiana dell 'Alluminio, in association with the Vereinigte Aluminum Werke of Germany, has raised its capital from 1,000,000 to 80,000,000 lire. It has acquired rights under the Haglund patents and will use Italian bauxite and pyrites from Montecatini to make alumina. A 6,000-ton aluminum works is to be built at Mori in Rovereto Province.[46]

Japan.—Japan [47] has been dependent on imported aluminum and imported 5,208 short tons of the metal in 1925 and 8,384 tons in 1926, most of which went to Kobe and to Osaka where the fabrication industry is centered. Most of the imported metal was in ingot form, 45 per cent of it being made into kitchen and other utensils, 35 per cent into transmission cables, 10 per cent into alloys, and the balance into automotive engine castings. The principal aluminum importing concern in Japan, the Asia Aluminum Co. (Ltd.) of Tokio, is organized under Japanese law by an American manufacturer and several Japanese business men. This company acts as sales agent for American, Canadian, and European aluminum companies. In 1926 an official Japanese commission, after a study of the possibilities of producing aluminum from domestic materials, found that the metal could be produced by the ammonia sulphate process at a cost of about $756 a ton, which is much above the cost of imported metal.

Norway.—The Norsk Aluminum Co., after much experimentation, is installing a plant to use domestic aluminous raw materials (?) for the production of aluminum. The new plant will have a capacity of 12,000 to 15,000 tons of alumina a year [48] and will follow the Pedersen patents. It will at first use French red bauxite, carrying 55 to 60 per cent Al_2O_3 and 23 per cent Fe_2O_3, produced by a subsidiary company, the Société anonyme des bauxites et aluminas de Provence.[49]

Production of aluminum in Norway in 1926 was 24,429 tons, of which 22,132 tons was exported. The British Aluminum Corporation is studying plans for an extension of its Glomfjord plant and has obtained a 50-year concession for the development of hydroelectric power amounting to 75,000 to 100,000 horsepower.[50]

Poland.—A Polish-Swiss company with 15,000,000 zloty capital, of which the Swiss interest is one-third, was organized to erect a plant to produce 2,400 to 3,000 tons of aluminum at Kattowitz. The raw material is from Upper Silesia and carries 25 per cent Al_2O_3.[51]

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[44] Journal du four électrique, 37th year, No. 4, April, 1928, p. 109.

[45] Journal du four électrique, 37th year. No. 2, February, 1928, p. 41.

[46] Commerce Reports, May 2, 1927, p. 306.

[47] Dickover, E. R., "Aluminum industry in Japan": Commerce Reports, Dec. 26, 1927, pp. 787-789.

[48] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, No. 175, Jan. 7, 1928.

[49] Mining Journal (London): Vol. 159, Dec. 10, 1927, p. 1026.

[50] Journal du four électrique, 36th year, No. 17, December, 1927, p. 259.

[51] Engineering and Mining Journal: Vol. 123, June 11, 1927, p. 972.

Russia.—It is reported[52] that a 3 ton a month experimental aluminum plant was in operation at the Leningrad Institute during 1927.

Among several industries which will be served by the Dnieprostroy hydroelectric power plant now under construction is an aluminum plant.[53] Work was started on the dam across the Dnieper River, which is planned for 650,000 horsepower and will take years to complete. It is hoped to have 60,000 horsepower available by January 1, 1933. The aluminum plant, with an annual capacity of 10,000 tons, will be near Zaporozhie.

It is reported[54] that the Aluminum Co. of America has concluded negotiations with the Soviet Government for the building of aluminum works in the region of Donetz near the Dnieprostroy hydroelectric development.

Spain.—The 1,500-ton plant of the Sociedad Aluminio Español for the manufacture of aluminum at Sabinanigo, Province of Huesca, began production in December, 1927.[55] The company was organized in 1925 with a capital of 4,000,000 pesetas.

Import rates on aluminum under a royal decree, published in the Gaceta de Madrid of March 30, 1928, were changed as follows:[56]

Item 456, aluminum in ingots and dross, from 8.80 to 75 pesetas.

Item 457, aluminum in bars or tubes and in tanks (cylinders?) for industrial use, weighing more than 50 kilos, from 22 to 150 pesetas.

Switzerland.—The annual report[57] of the Société pour l'industrie de l'aluminium (Neuhausen) for 1926 indicates that the year was not very good for Swiss makers of aluminum and that the price of metal was lowered in the autumn to increase sales. The company, besides being connected with the French and German makers, is interested in the new plant erected in Spain, which began operations in 1927, and in the new works to be erected at Venice, Italy.

Aluminum exported from Switzerland in 1927 amounted to 18,394 tons as compared with 18,705 tons in 1926.[58]

The Société pour l'industrie de l'aluminium (Neuhausen) in 1927 declared a dividend of 150 francs and a bonus of 100 francs. It has increased its capital by 50,000 shares, 100 francs each bearing 5 per cent interest, and has a capitalization of 55,000,000 francs.[59]

ALUMINUM SALTS

Manufacturers of aluminum salts reported a consumption of 137,870 long tons of bauxite in 1927, having an average value of $13.47 a ton at the plant, as compared with 114,570 tons in 1926, with an average value of $11.08 a ton. Of the bauxite consumed in 1927, 79,130 tons was domestic bauxite, valued at $991,590, and 58,740 tons was imported bauxite, valued at $866,000. An unrecorded quantity of high-alumina clay, 2,780 tons of alumina hydrate, and 720 tons of aluminum were also used in the preparation of aluminum salts. These figures do not include the bauxite made into alumina as a preliminary step in the manufacture of aluminum.

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[52] Bureau of Foreign and Domestic Commerce, Foreign Trade Notes, No. 153, Aug. 6, 1927, p. 3.

[53] Economic Review of the Soviet Union, "The economic significance of Dnieprostroy": Vol. 3, No. 9, May 1, 1928, pp. 157–159.

[54] Journal du four électrique, 37th year, No. 4, April, 1928, p. 109.

[55] Journal du four électrique, 36th year, No. 17, December, 1927, p. 258.

[56] Commerce Reports, Apr. 16, 1928, p. 189.

[57] Journal du four électrique, 36th year, No. 6, April, 1927, p. 88.

[58] Journal du four électrique, 37th year, No. 4, April, 1928, p. 109

[59] Journal du four électrique, 37th year, No. 4, April, 1928, p. 113.

Aluminum salts produced in the United States, 1926–27

Salt	1926				1927			
	Number of producers reporting	Short tons	Value		Number of producers reporting	Short tons	Value	
			Total	Average			Total	Average
Alum:								
Ammonia	5	4, 560	$276, 480	$61	5	5, 200	$319, 820	$62
Sodium	6	16, 740	953, 840	57	3	14, 230	928, 870	65
Alumina, calcined and hydrate	3	3, 910	287, 660	74	(1)	(1)	(1)	------
Aluminum chloride:								
Liquid	5	16, 750	3, 562, 690	213	4	2, 760	139, 830	51
Crystal					3	270	36, 130	134
Anhydrous					3	14, 100	3, 878, 120	275
Aluminum sulphate:								
Commercial—								
General	14	307, 550	7, 374, 940	24	14	309, 400	7, 708, 450	25
Municipal	5	7, 130	134, 590	19	5	6, 810	149, 540	22
Iron-free	7	16, 160	557, 460	34	8	20, 210	706, 910	35
Other aluminum salts	--------	895	54, 350	--------	[2] 6	5, 790	420, 760	------
	--------	373, 695	13, 202, 010	35	--------	378, 770	14, 288, 430	38

[1] Included under "Other aluminum salts."
[2] Two producers each of potash alum, alumina, and sodium aluminate.

Aluminum salts produced in, imported into, and exported from the United States, 1923–1927

Year	Domestic production		Imports		Exports (aluminum sulphate)	
	Short tons	Value	Short tons	Value	Short tons	Value
1923	289, 904	$8, 987, 421	2, 318	$120, 663	17, 805	$505, 732
1924	302, 190	9, 301, 410	2, 523	113, 075	16, 012	407, 749
1925	335, 480	13, 155, 790	3, 205	140, 518	20, 756	505, 537
1926	373, 695	13, 202, 010	2, 937	140, 994	22, 031	521, 123
1927	378, 770	14, 288, 430	1, 845	83, 288	21, 128	491, 317

ALUMINOUS ABRASIVES AND REFRACTORIES

The use of aluminous abrasives and high-alumina refractories continues to grow. Makers of artificial abrasives took 71,790 long tons of domestic bauxite in 1927. Expansion is shown by the increasing demand for high-alumina clays and other aluminous minerals by ceramists all over the country. In 1927 the makers of refractory brick took 160 long tons of domestic bauxite and 40,085 short tons of high-alumina (diaspore) clay. Andalusite and dumortierite were shipped in increasing amounts during 1927 from deposits in California and Nevada for use as aluminous ceramic materials. Alumina by-product in excess of 1,200 tons was shipped from Marysvale, Utah, to California and New Jersey makers of refractories.

ALUMINA CEMENTS

Domestic bauxite to the amount of 90 long tons was reported by producers as sold to makers of high-alumina cement in 1927, and it is known that more than 23,000 tons of foreign bauxite, mostly Dalmatian, was consumed by this industry. The use has expanded and many engineering data have been accumulated which tend to prove the value of this cement for certain uses and for use where time and cost are important elements.

PLATINUM AND ALLIED METALS

By James M. Hill[1]

CRUDE PLATINUM

Mine returns for 1927 indicate a production of 20 troy ounces of crude platinum in Alaska, 127 ounces in California, and 6 ounces in Oregon, a total of 153 ounces for the United States. In 1926 Alaska produced 10 ounces, California 269 ounces, and Oregon 7 ounces.

Platinum refiners report purchases of domestic platinum in 1927, as follows: Alaska, 10 ounces; California, 189 ounces; Oregon, 37 ounces—a total of 236 ounces, or 65 ounces more than refiners purchased in 1926. Refiners also report purchases of 48,907 ounces of foreign crude platinum in 1927—1,390 ounces from Australia, 19 ounces from Canada, 43,557 ounces from Colombia, 17 ounces from Russia, and 3,924 ounces from South Africa. The total is 5,811 ounces more than the purchases reported in 1926. According to the Bureau of Foreign and Domestic Commerce, the imports of platinum from Colombia during 1927 were 52,050 ounces, and the total imports of unmanufactured platinum were 128,544 ounces, an increase of 12 per cent as compared with imports of crude in 1926.

REFINED PLATINUM METALS

NEW METALS

Reports of refiners of crude platinum, gold bullion, and copper indicate that 46,050 ounces of platinum metals were recovered in the United States from these sources in 1927, a decrease of 38,931 ounces, or 46 per cent, as compared with recoveries in 1926. It is estimated that 8,173 ounces of the total quantity in 1927 were derived from domestic sources.

New platinum metals recovered by refiners in the United States, 1918–1927, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1918	54, 399	4, 024	465	539	326	59, 753
1919	40, 220	3, 807	401	402	279	45, 109
1920	36, 015	4, 309	418	409	393	41, 544
1921	51, 791	2, 686	286	581	1, 026	56, 370
1922	54, 142	1, 943	210	1, 301	122	57, 718
1923	46, 780	1, 934	280	787	16	49, 797
1924	57, 827	6, 065	680	1, 261	174	66, 007
1925	41, 300	7, 358	283	648	54	49, 643
1926	76, 154	6, 437	234	2, 113	43	84, 981
1927	41, 121	3, 879	256	631	163	46, 050

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[1] Helen M. Gaylord, of the Bureau of Mines, assisted in the preparation of this report. The figures on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, of the Bureau of Mines.

New platinum metals recovered by refiners in the United States, 1926 and 1927, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1926						
Domestic:						
Crude platinum	96	1	23	13	7	140
Ore		3, 330				3, 330
Gold and copper refining	4, 827	2, 856	3		9	7, 695
	4, 923	6, 187	26	13	16	11, 165
Foreign:						
Crude platinum	32, 668	250	208	2, 100	27	35, 253
Gold and copper refining	38, 563					38, 563
	71, 231	250	208	2, 100	27	73, 816
Total recovery	76, 154	6, 437	234	2, 113	43	84, 981
1927						
Domestic:						
Crude platinum	84	1	46	30	3	164
Ore		108				108
Gold and copper refining	4, 365	3, 528			8	7, 901
	4, 449	3, 637	46	30	11	8, 173
Foreign: Crude platinum	36, 672	242	210	601	152	37, 877
Total recovery	41, 121	3, 879	256	631	163	46, 050

SECONDARY METALS

Secondary platinum metals are those recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum. Although the figures in the following table undoubtedly contain some duplication, it is believed that they are worth publishing.

Secondary platinum metals recovered in the United States, 1918–1927, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1918	40, 378	1. 795	3, 410		45, 583
1919	54, 545	3, 467	3, 504		61, 516
1920	51, 255	3, 100	3, 355		57, 710
1921	39, 131	4, 887	1, 776	229	46, 023
1922	40, 062	4, 193	1, 937	496	46, 688
1923	39, 152	6, 246	2, 021	453	47. 872
1924	45, 474	5, 784	2, 200	1, 013	54, 471
1925	35, 578	4, 680	1, 827	1, 189	43, 274
1926	38, 795	5, 647	1, 478	217	46, 137
1927	46, 127	4, 244	1, 810	891	53, 072

IMPORTS AND EXPORTS

Platinum metals imported for consumption in the United States, 1918–1927

Year	Troy ounces	Value	Year	Troy ounces	Value
1918	56, 756	$5, 167, 908	1923	106. 637	$10, 466, 705
1919	68, 054	6, 747, 447	1924	111, 359	11, 030, 349
1920	100, 546	10, 617, 440	1925	125, 802	13, 230, 148
1921	78, 378	5, 418, 464	1926	134, 797	13, 451, 835
1922	110, 025	8, 983, 547	1927	148, 769	12, 413, 494

Platinum metals imported for consumption in the United States, 1926 and 1927, by metals

Metal	1926			1927		
	Troy ounces	Value		Troy ounces	Value	
		Total	Average		Total	Average
Platinum:						
Ores of platinum metals (platinum content)	1,221	$124,668	$102.10	----------	----------	----------
Grains, nuggets, sponge, or scrap	87,162	8,683,359	99.62	90,491	$7,480,869	$82.67
Ingots, bars, sheets, or plates, not less than ⅛ inch thick	26,585	2,995,582	112.68	38,053	3,707,062	97.42
	114,968	11,803,609	102.67	128,544	11,187,931	87.04
Manufactures of, except jewelry	5	646	129.20	37	5,812	157.08
Iridium	3,305	411,646	124.55	4,633	520,202	112.28
Osmiridium	684	64,714	94.61	7,506	397,408	52.95
Osmium	5,457	594,042	108.86	6	277	46.17
Palladium	8,258	460,015	55.71	6,251	222,878	35.65
Rhodium	1,362	78,907	57.93	1,308	59,940	45.83
Ruthenium	758	38,256	50.47	484	19,046	39.35
	134,797	13,451,835	99.79	148,769	12,413,494	83.44

Platinum metals (unmanufactured) imported into the United States, 1926 and 1927, by countries, in troy ounces

[General imports]

Country	Platinum (grains, scrap, ingot, etc.)	Palladium	Iridium	Osmium and osmiridium	Rhodium and ruthenium	Total
1926						
Australia	4	----------	----------	1,665	----------	1,669
British South Africa	----------	----------	----------	36	----------	36
Canada	1,433	1,133	15	124	191	2,896
Chile	176	----------	----------	----------	----------	176
China	12	----------	----------	19	----------	31
Colombia	39,004	9	3	8	----------	39,024
France	11,419	122	367	343	399	12,650
French Indo-China	106	----------	----------	----------	----------	106
Germany	2,347	549	346	----------	----------	3,242
Latvia	1,976	----------	----------	----------	----------	1,976
Mexico	895	----------	----------	----------	----------	895
Nicaragua	8	----------	----------	----------	----------	8
Panama	2,167	----------	----------	----------	----------	2,167
Philippine Islands	4	----------	----------	----------	----------	4
United Kingdom	55,417	6,445	2,574	3,946	1,530	69,912
	114,968	8,258	3,305	6,141	2,120	134,792
1927						
Australia	25	----------	----------	852	----------	877
Canada	1,679	978	----------	----------	571	3,228
China	5	----------	----------	----------	----------	5
Colombia	52,050	6	136	30	----------	52,222
Cuba	1	----------	----------	----------	----------	1
Finland	----------	66	22	----------	6	94
France	2,255	64	298	----------	344	2,961
Germany	26,578	50	2,719	22	38	29,407
Guatemala	----------	----------	50	369	----------	419
Latvia	19	----------	----------	----------	----------	19
Mexico	6	----------	----------	----------	----------	6
Panama	611	----------	----------	----------	----------	611
Soviet Russia	4,179	----------	923	----------	----------	5,102
United Kingdom	41,136	5,087	485	6,239	833	53,780
	128,544	6,251	4,633	7,512	1,792	148,732

Platinum exported from the United States, 1918–1927

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1918	119	$13, 511	(1)	$23, 562
1919	522	75, 066	(1)	54, 529
1920	1, 302	177, 115	(1)	111, 014
1921	3, 272	244, 473	741	85, 216
1922 Crude, scrap, and old	143	13, 149	486	35, 967
Ingots, sheets, wire, and alloys	1, 313	127, 047		
1923	1, 151	128, 599	592	65, 073
1924	5, 854	643, 282	1, 274	136, 948
1925	16, 234	1, 787, 122	3, 537	249, 975
1926	11, 573	1, 253, 795	1, 898	160, 648
1927	19, 923	1, 577, 560	1, 549	128, 875

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(1) Quantity not recorded.

CONSUMPTION

According to reports from refiners the consumption of platinum metals in the United States in 1927 was 149,686 ounces, a decrease of 13 per cent as compared with 1926. The chemical industry used 627 ounces more than in 1926, most of which was platinum. The electrical industry used 2,931 ounces less than in 1926, decreasing its consumption of platinum and palladium. The dental industry consumed approximately the same total quantity of platinum metals as in 1926 but used more palladium and less platinum in 1927. The jewelers decreased their consumption by 2,951 ounces, using only about half as much palladium but nearly 38 per cent more iridium. The quantity of platinum metals consumed for miscellaneous uses was only one-fourth as large as in 1926.

Platinum metals consumed in the United States as reported by refiners, 1926 and 1927, by industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percentage of total
1926						
Chemical	10, 253	213	145	228	10, 839	6
Electrical	16, 765	3, 508	1, 608	185	22, 066	13
Dental	8, 542	11, 063	131	----------	19, 736	11
Jewelry	85, 908	7, 770	2, 949	454	97, 081	57
Miscellaneous	17, 381	2, 181	581	1, 751	21, 894	13
	138, 849	24, 735	5, 414	2, 618	171, 616	100
1927						
Chemical	11. 010	180	101	175	11, 466	8
Electrical	14, 905	2, 491	1, 618	121	19, 135	13
Dental	7, 504	12. 194	153	----------	19, 851	13
Jewelry	86, 036	3, 706	4, 059	329	94, 130	63
Miscellaneous	3, 176	312	305	1, 311	5, 104	3
	122, 631	18, 883	6, 236	1, 936	149, 686	100

STOCKS

Stocks of the platinum metals in the hands of refiners on December 31, 1927, amounted to 102,056 ounces, a decrease of 3 per cent as compared with the stocks at the beginning of the year.

Stocks of platinum metals in the hands of refiners in the United States, December 31, 1918–1927, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1918	51,504	10,086	3,224	----------	64,814
1919	29,228	10,235	3,359	610	43,432
1920	46,747	16,565	4,196	216	67,724
1921	38,514	21,042	4,991	3,113	67,660
1922	41,900	24,975	7,559	1,583	76,017
1923	36,554	26,266	5,208	2,697	70,725
1924	40,464	27,400	3,622	3,053	74,539
1925	44,024	26,740	3,720	4,609	79,093
1926	64,203	31,950	3,933	5,485	105,571
1927	68,757	24,313	4,617	4,369	102,056

MARKET AND PRICES

CRUDE PLATINUM

Sellers of domestic crude platinum reported they were paid for metal content based on assay, and no figure can be given for crude platinum. Buyers reported purchases at $50 to $80 an ounce for domestic and $42 to $102 for foreign crude platinum. Buyers of foreign and domestic crude platinum in the United States who reported purchases in 1927 are as follows:

American Platinum Works, 325 New Jersey Railroad Avenue, Newark, N. J.
Baker & Co. (Inc.), Murray and Austin Streets, Newark, N. J.
J. Bishop & Co. Platinum Works, Malvern, Pa.
Sigmund Cohn, 44 Gold Street, New York, N. Y.
Thomas J. Dee & Co., 1010 Mallers Building, Chicago, Ill.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works (Inc.), 814 South Spring Street, Los Angeles, Calif.
R. & H. Platinum Works (Inc.), 709 Sixth Avenue, New York, N. Y.
Shreve & Co. Post Street and Grant Avenue, San Francisco, Calif.
Superior Metals Corporation, 608 Commercial Street, San Francisco, Calif.
L. E. Waterman Co., New York, N. Y.
Western Gold & Platinum Works, Phelan Building, San Francisco, Calif.
Wildberg Bros., 742 Market Street, San Francisco, Calif.
H. A. Wilson Co., 97 Chestnut Street, Newark, N. J.

REFINED METALS

Quotations[2] on pure platinum at the first of the year were $112 an ounce, but the market was declining and by May 9 the price had reached $86 and by June 1 was $72, which price was maintained to the end of the year. The open market price for large lots was nearly uniform at $6 an ounce under the quoted price. Refiners reported the high price for platinum at $110, the low at $75, and the average for the year as $84 an ounce.

Iridium, 98 to 99 per cent sponge and powder, was quoted at $120 to $125 an ounce the first of the year, but the price declined to $115 to $120 late in January and to $105 to $110 the middle of May. Prices recovered slightly in June and July but did not go above $112 an ounce and sagged to $105 to $108 an ounce in October. In November quotations stood at $110 to $115 an ounce and continued at that figure to the end of the year. Refiners gave the following prices: High, $400; low, $105; and average for the year, $120 an ounce.

Quotations[2] on palladium at the first of the year were $63 to $66 an ounce, by the third week in January declined to $55 to $60, and the first of February rose to $58 to $62, a price that was maintained until the middle of March. Prices then advanced to $59 to $63 but sagged again to $53 to $57 the first week of May and to $52 to $54 by the middle of July, continuing to decline slowly until the low of the year was reached, $50 to $52 an ounce the second week in December. Refiners reported a high of $72, a low of $50, and an average price for the year of $58 an ounce.

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[2] Engineering and Mining Journal: Vols. 123 and 124, 1927.

Rhodium quotations varied from a high of $65 to $75 an ounce at the first of the year to a low of $50 to $52 an ounce at the end of December, but for most of the year the price was $55 an ounce.

Osmium quotations at the beginning of the year were $65 to $70 an ounce, the middle of January dropped to $55 to $60, and in July recovered to $60 to $65 an ounce, a price that was maintained until the end of the year.

Ruthenium quotations opened the year at $50 to $55 an ounce but fell to $40 in February and to $35 to $38 the latter part of October.

The platinum market during 1927 was far from satisfactory to either producers or consumers. Russia's action in April in entering the American market directly instead of through the established selling channels resulted in price declines which were out of line with market demands. The platinum metals are essentially "luxury metals," their chief consumption being for jewelry; in this industry the high price of the product is of prime importance. As pointed out in editorials in both American and English journals,[4] it would be much better for the industry to return to the controlled market which prevailed up to April, 1927. At the end of 1927 and continuing into 1928 there was a remarkable advance in the prices of all platinum metals. While the Russplatina has denied that negotiations to reestablish the platinum control are being carried on,[5] it appears that the Soviet selling organization has come to the conclusion that the market for platinum metals can not expand indefinitely by lowering of prices.

WORLD'S PRODUCTION

World's production of crude platinum from placers, 1918–1926, in troy ounces

Country	1918	1919	1920	1921	1922	1923	1924	1925	1926
Australasia:									
New South Wales	607	213	796	249	80	586	646	573	397
Papua (osmiridium) [a]	([b])	([b])	100	360	100	[c] 145	[c] 119	[c] 116	[c] 49
Tasmania (osmiridium)	1,607	1,670	2,009	1,751	1,174	673	365	3,366	3,173
Canada	[d] 40	[d] 30	[d] 25	[d] 15	[d] 15	[d] 10	5	6	50
Colombia [e]	35,000	35,000	35,000	35,500	40,000	42,000	46,000	[f] 45,000	46,000
India (British)	([g])	--------	--------	--------	--------	--------	--------	--------	--------
Japan	51	155	258	231	150	224	145	189	198
Mexico	--------	--------	--------	--------	--------	--------	--------	--------	30
New Zealand	--------	--------	--------	--------	--------	--------	--------	--------	31
Philippine Islands	--------	--------	--------	--------	1	14	--------	4	8
Russia	[e] 25,000	[e] 30,000	[e] 35,000	[e] 20,000	27,200	38,000	66,800	94,800	92,700
United States	647	824	613	977	1,008	609	335	343	286

[a] For year ended June 30 of year stated.
[b] Figures not available, but annual output did not exceed 10 ounces.
[c] Exports.
[d] Estimated by J. M. Hill. The Dominion Bureau of Statistics Ann. Repts. give the placer output of Canada, in troy ounces, as follows: 1918, 39; 1919, 25; 1920, 17; 1921, 23; 1922, 12; 1923, 7.
[e] Estimated by J. M. Hill.
[f] Revised figures, based on data personally communicated to the author.
[g] Production, 0.31 ounce.

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[4] Engineering and Mining Journal: Vol. 124, Aug. 13, 1927, p. 243. Wall Street Journal, Dec. 19, 1927, p. 5. Mining Journal (London): Vol. 160, Feb. 4, 1928, pp. 92–93.

[5] Economic Review of the Soviet Union: Vol. 3, No. 3, Feb. 1, 1928, p. 47. Jewelers Circular: Vol. 95, Jan. 26, 1928, p. 95.

The following table gives data by which the figures showing the production of crude platinum as given in the foregoing table can be reduced to terms of the refined metals used by the industries:

Average assay of crude platinum, in per cent

Country	Platinum	Palladium	Iridium	Osmium	Rhodium, ruthenium, etc.
Australasia:					
New South Wales	75.9		1.3		1.3
Papua			58.1	33.5	3.0
Tasmania			58.1	33.5	3.0
Canada	72.1	0.2	1.1		2.8
Colombia	96.2	.5	1.1		1.4
Japan	.2		49.8	37.3	3.9
Russia	83.5	1.9	1.9	3.0	.6
United States	85.5	.6	1.1	1.3	1.0

LEGISLATION

A platinum stamping law almost identical to the Illinois and New York provision, which became effective January 1, 1928, has been signed by the Governor of New Jersey and will become effective July 4, 1929.[6]

The Jewelry Crafts Association of New York in its December (1927) bulletin has given a summary of the provisions of the New York law, which is reprinted as being of importance to the platinum industry.

New platinum stamping law, New York State, effective January 1, 1928

[Marking of articles in accordance with section 1639, pars. a, b, c, d, e, f]

Articles made of—		Example
(*a*) 95 per cent platinum; balance metals of platinum group.	May be marked platinum	Platinum.
(*b*) 75 per cent platinum; balance metals of platinum group.	May be marked platinum provided immediately preceding the mark "Plat." there is marked the name or abbreviation of the predominating metal of the platinum group. Such predominating other metal must be more than 50/1000ths part of the entire article.	Irid-plat.
(*c*) More than 50 per cent platinum; balance metals of platinum group.	May be marked platinum provided said word is immediately preceded by a decimal fraction in thousandths showing the platinum content in proportion to the content of the entire article, and further provided that said mark "Platinum" be followed by the name or abbreviation of such one or more of the following metals: Iridium, palladium, ruthenium, rhodium and/or osmium that may be present in the article in quantity not more than 50/1000ths parts of the entire article. The name of each such other metal or metals other than platinum shall be preceded by a decimal fraction in one thousandths showing the content of such other metal or metals in proportion to the entire article.	.600 Plat. .350 Pall. or .500 Plat. .200 Pall. .150 Ruth. .100 Rhod.
(*d*) Less than 50 per cent platinum; balance metals of the platinum group.	May be marked with the name iridium, palladium, ruthenium, rhodium, and/or osmium, whichever predominates in the article, but in no event with the mark "Platinum," provided, however, that the quantity of such metal other than platinum so marked must be marked in decimal thousandths, and provided further that the name of such metal other than platinum so used must be spelled out in full, irrespective of any other provisions of this article to the contrary.	.600 Pall.

[6] Jewelers Circular: Vol. 96, April 5, 1928, p. 88.

New platinum stamping law, New York State, effective January 1, 1928—**Contd.**

Articles made of—		Example
(*e*) Platinum and gold resembling or appearing to be platinum.	May be marked with a karat mark and the word platinum, provided the fineness of the gold shall be correctly described by the karat mark and the percentage of platinum shall be no less than 5 per cent in weight of the total weight of the article. The entire marking must be so applied that the karat mark shall immediately precede the word "Platinum" and each shall be equal in size. Should the platinum content exceed 5 per cent, the quality mark may also include a declaration of the percentage of platinum.	14K & Plat. 18K & Plat. 18K & 1/10th Plat. 14K & 1/8th Plat.
(*f*) Platinum and any other metal resembling or appearing to be platinum.	May be marked with the quality mark "Platinum," provided all parts or portions of article resembling platinum shall be at least 985/1000ths parts pure platinum.	Platinum (on the platinum part only).

The national platinum stamping measure which died in the 1926 Congress was again introduced on December 5, 1927, as H. R. 5639 but failed to pass.

METALLURGY

Davis,[7] at the suggestion of T. W. Gruetter, of Grants Pass, Oreg., studied the glow reaction for detection of platinum metals originated by Curtman and Rothberg in 1911 and found that acid solutions of copper, copper-nickel alloy, and copper salts gave positive reaction for metals of the platinum group when the tests were carried out in the old way. He also found that the Curtman-Rothberg method may be applied safely only in the absence of copper, cobalt, nickel, and silver. Davis gives details of a modified glow reaction procedure which is more reliable.

The metallurgy of platinum metals has not been given much publicity in the past few years. As a matter of fact, refiners are rather loath to give details of procedure. It is therefore of interest that at the February, 1928, meeting of the American Institute of Mining and Metallurgical Engineers a series of papers on this subject was given.

Carter,[8] of the Research Department of Baker & Co., submitted a general paper on the sources of platinum and the metallurgy, melting, and working of the metals of the platinum group. Data on the effect of gases on the various metals of this group are given, as well as a table of their physical properties. He discusses various platinum alloys and their uses in the different consuming industries.

Wickers, Gilchrist, and Swanger,[9] of the Bureau of Standards, submitted a paper on the purification of the metals of the platinum group, giving in summary form the various steps necessary in the preparation of pure metals, which, they state, "are suitable for small-scale refineries as well as for the laboratory."

Whiteley and Dietz,[10] of the Dentists Supply Co., submitted a paper on commercial refining of platinum scrap high in iridium and ruthenium, which does not go into solution readily in aqua regia;

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[7] Davis, C. W., "The glow test for metals of the platinum group": Jour. Frank. Inst., May, 1927, pp. 679–699.

[8] Carter, F. E., "The platinum metals and their alloys": Am. Inst. Min. and Met. Eng., Tech. Pub. No. 70, Class E, Institute of Metals, No. 27, 1928.

[9] Wickers, Edward, Gilchrist, Raleigh, and Swanger, Wm. H., "Purification of the six platinum metals": Am. Inst. Min. and Met. Eng., Tech. Pub. No. 87, Class E, Institute of Metals, No. 30, 1928.

[10] Whiteley, J. O., and Dietz, C., "Refining and melting some platinum metals": Am. Inst. Min. and Met. Eng., Tech. Pub. No. 84, Class E, Institute of Metals, No. 29, 1928.

the paper also contained a brief discussion of the melting and working of platinum.

Williams,[11] of the Williams Gold Refining Co., indicated the many varieties of requirements of the metals and alloys used in dentistry and the necessity of close cooperation between the dentists and the makers of dental alloys to assure success in the work. He discussed various mechanical problems, particularly in casting the intricate patterns of dental molds.

Kingsbury,[12] of the Bell Telephone Laboratories (Inc.), pointed out that whereas the electrical industry formerly consumed about one-eighth of the total consumption of the platinum metals, in recent years one-half of the normal demand of the electrical industry for noble metals has been met by substitutes, some of which are superior to platinum for contact work. The platinum-25 per cent iridium alloy is probably the most extensively used of the noble-metal alloys for contact work. The type of material to be most serviceable for any particular contact differs with the work to be done. Contact resistance, the erosion of the electrodes, and building up of electrodes because of transfer of metal were discussed in detail.

NOTES ON PLATINUM DEPOSITS

Vogt,[13] after reviewing the occurrence of platinum deposits in Russia, which show concentration of platinum metals and chromite in magnesian rich igneous rocks by concentric magmatic differentiation, turns to the deposits in the Bushveld Complex in South Africa. He then discusses the copper-nickel-sulphide type of deposits carrying platinum, as at Sudbury and the Merensky Reef in South Africa, and briefly the rare occurrences of platinum in quartz veins. He concludes that "ore deposits carrying noteworthy contents of platinum (or platinum metals) are with some few exceptions formed by magmatic concentration." He groups the principal deposits under two main heads, as follows:

I. Primary deposits especially of native platinum in dunite.
    A. Ural type—in ordinary dunite, end product of magmatic differentiation, resulting in segregations of chromite, native platinum, and osmiridium.
    B. Onverwacht type—in hortonolite dunite; in irregular coarse-grained even pegmatic veins; in olivine dunite.
II. Magmatic segregations of nickeliferous pyrrhotite in norite.
    A. Sudbury—Erteli type with relatively large quantities of sulphides and very small content of platinum metals.
    B. Merensky type—with 3 to 4 per cent sulphides, 8 to 10 per cent nickel, and about 5 grains platinum metal a ton.

UNITED STATES

The United States Geological Survey reports that the production of placer platinum in Alaska in 1927 was 20 ounces, and that the Salt Chuck mine, which produces palladium-bearing copper ore, was not in operation.

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[11] Williams, R. V., "Metallurgical properties of precious metals and their alloys which affect their use in dentistry": Am. Inst. Min. and Met. Eng., Tech. Pub. No. 99, Class E, Institute of Metals, No. 39, 1928.

[12] Kingsbury, E. F., "Use of the noble metals for electrical contacts": Am. Inst. Min. and Met. Eng., Tech. Pub. No. 95, Class E, Institute of Metals, No. 37, 1928.

[13] Vogt, J. H. L., "Geology of the platinum metals": Econ. Geol., vol. 22, 1927, pp. 321-355.

As usual the great bulk of the platinum produced in California was saved as a by-product by the dredges at the base of the Sierra Nevada Mountains. The total quantity of crude platinum sold by mining companies in 1927 was 216 ounces, as compared with 269 ounces in 1926. Refiners reported the purchase of 189 ounces of California crude platinum in 1927.

In southwest Oregon there was apparently little mining on the beaches, as the miners reported sales of only 4 ounces in 1927. The refiners, however, reported purchases of 37 ounces of platinum from Oregon during the year. The Oregon production in 1928 should increase somewhat, as a large hydraulic mine near Kerby will be producing, working in gravels known to contain platinum.

It is reported that the Key West Mines Co. has been refinanced and will reopen the old Key West mine near Bunkerville, Clark County, Nev. This deposit of basic igneous rock carries platinum and palladium in association with copper and nickel.

No production of platinum metals was recorded from the mines near Holmes, Albany County, Wyo., from which platinum-palladium-bearing copper ores have been produced in the past.

AUSTRALASIA

Production of platinum metals in 1926 was 397 ounces from New South Wales (573 ounces in 1925), 49 ounces of osmiridium from Papua (116 ounces in 1925), and 3,173 ounces of osmiridium from Tasmania (3,366 ounces in 1925). The production of osmiridium in Tasmania in 1927 was 633 ounces, all from the Adams River field.[14]

Lennon [15] has described the difficulties of mining osmiridium in the Adams River field in the western part of Tasmania. This district, discovered in 1925, had 2,000 men at work at one time, but the richer deposits were soon exhausted, and Lennon does not believe that any large production can be expected from the district in the future.

CANADA

The production of crude platinum in Canada in 1926 was 50 ounces. Platinum refiners in the United States reported purchases of 23 ounces of Canadian crude platinum in 1926 and 19 ounces in 1927. In 1926 there was also produced 9,471 ounces of platinum, valued at $919,349, and 10,024 ounces of other platinum-group metals, mostly palladium, valued at $640,178, by the refining of nickel-copper ores from the Sudbury district, Ontario. Recoveries of platinum metals in 1927 from Sudbury ores are 11,217 ounces of platinum and 11,545 ounces of other platinum-group metals.

Robie [16] has recently discussed the present position of the International Nickel Co. Langer and Johnson,[17] of the Mond Nickel Co., published an account of the recovery of the platinum metals from the Sudbury ores.

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[14] Industrial Australian and Mining Standard (Melbourne): Mar. 22, 1928.

[15] Lennon, P. O., "Osmiridium mining in Tasmania": Min. Mag. (London), vol. 37, Dec. 1927, pp. 343–349. Engineering and Mining Journal: Vol. 123, Apr. 23, 1927, pp. 688–689.

[16] Robie, E. H., "International Nickel": Eng. and Min. Jour., vol. 124, Aug. 27, 1927, pp. 325–328.

[17] Langer, C., and Johnson, C., Precious Metals of the Platinum Group in the Sudbury Nickel-Copper Ores: Canadian Inst. Min. and Met. Bull., July, 1927. Reviewed in Min. Mag. (London), vol. 37, 1927, pp. 123–124.

COLOMBIA

It is estimated that the production of crude platinum in Colombia in 1926 was approximately 46,000 ounces. Upon receipt of later data it was found necessary to revise the estimate for the 1925 output from 62,000 to 45,000 ounces. The figures of exports of platinum through the ports of Cartagena and Buenaventura indicate that production during 1927 was at least equal to the 1926 output. Domestic refiners of platinum metals reported purchases of 37,564 ounces of Colombian crude platinum in 1926 and of 43,557 ounces in 1927.

The South American Gold & Platinum Co. produced more platinum in 1926 than ever in its history, nearly 19,000 ounces, and for 1927 is reported to have made an even larger recovery. During 1926 the No. 1 boat was in operation from March to November, when it was shut down for rebuilding and electrification. The No. 1 boat, rebuilt and electrified, was placed in operation on July 1, 1927. The No. 2 and No. 3 boats operated throughout the year.

The British Platinum & Gold Corporation (Ltd.) sunk and abandoned the No. 1 boat and suspended operations on the No. 2 boat at the end of 1927.[18] A receiver has been appointed, as the only remaining assets are the company's questionable rights in the Salto property, which the lower courts of Colombia determined belonged to the South American Gold & Platinum Co. An appeal has been filed from that decision.

Leighton [19] describes the methods used at clean-up time by the British Platinum & Gold Corporation and gives details of a pulsation jig machine developed at the property for treating the minus 20-mesh material for the separation of gold and platinum from the heavy sands.

On November 18, 1927, a new income tax law (Ley Numero 64) was passed in Colombia, under which nonresidents pay a tax on total net revenue derived from any source within the country. The tax is levied on a sliding scale, ranging from 1 per cent on a net revenue of 2,000 pesos to 8 per cent on 500,000 pesos or over. These rates apply to income earned in 1927.[20]

RUSSIA

The production of crude platinum in Russia in 1926 is estimated at approximately 92,700 ounces and that for 1927 at only slightly more than that figure. Amtorg (Soviet trading agency in New York) reports that sales of Russian platinum metals in the United States for the fiscal year ended September 30, 1927, were valued as follows: Platinum, $1,350,571; iridium, $46,033; and palladium, $3,081.[21] In 1926 there were no importations direct from Russia.

As the Uralplatina, the Soviet Russian platinum trust, did not renew the selling agreement that had prevailed up to the end of March, 1927, the world market for platinum metals was disrupted. Since April, 1927, Russian platinum has been sold at prices much below those maintained by this trust and in much larger quantities than the world market could absorb without a great reduction of prices.

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[18] Mining Magazine (London): Vol. 38, Feb., 1928, p. 72.

[19] Leighton, F. W., "Method of cleaning-up on a platinum dredge": Min. Mag. (London), vol. 37, Aug,. 1927, pp. 92-94.

[20] Commerce Reports: Feb. 20, 1928, p. 518.

[21] Ropes, E. C., Foreign trade of Soviet Russia in 1926-27. Commerce Reports, Feb. 6, 1928, p. 327.

It is claimed that the known Russian reserves of platiniferous gravels containing 0.04 ounce per yard will supply 1,500,000 ounces of platinum when dredged under modern conditions with dredges similar to those bought in the United States in 1925. Professor Lipovsky estimates that there are reserves of 7,000,000 ounces of platinum in Russia.[22] Russian crude platinum is now refined at plants located at Moscow and Sverdlovsk (formerly Ekaterinburg).

It is interesting to note in view of the large sales of platinum by the Uralplatina in 1927 that the reserve of platinum in the State Bank of the Soviet Union, which was 3,038,356 chervontzi on February 1, 1927, had declined to 2,467,440 on February 1, 1928.[23]

SIERRA LEONE

The British Colonial Office recently gave out a statement concerning the discovery of platinum in Sierra Leone.[24] The discovery was made in May, 1926, by the director of the Geological Survey. The alluvial deposits in an area of 40 square miles are reported to be of considerable importance. Basic igneous rocks similar to the Bushveld are present in the region. The Government of Sierra Leone will give details to financially competent firms or persons who would be interested in mining these deposits but reserves the power to limit the number of prospecting rights issued.

UNION OF SOUTH AFRICA

The production of osmiridium from the treatment of the Rand "banket" ores during 1926 was 6,228 ounces, and sales of osmiridium during the year amounted to 6,360 ounces, valued at £96,734.[25] Most of the production was from the large mines in the Witwatersrand district, but a few ounces was saved in the Heidelberg district.

The assay content of the osmiridium sold in 1926 was as shown below. The percentages of the various constituent metals vary a good deal, and, taking the osmiridium from the Witwatersrand large gold mines only, the following are the maximum and minimum percentages:

	Minimum percentage	Maximum percentage		Minimum percentage	Maximum percentage
Osmium	23.31	40.65	Platinum	4.60	14.44
Iridium	21.93	35.71	Rhodium	Nil.	.56
Ruthenium	8.73	15.82	Gold	Nil.	18.00

The ratio of one constituent to another also fluctuates, but osmium is the predominant metal, closely followed by iridium.

During 1926 the first production of platinum was made from the treatment of the dunite deposits in the Waterberg and Lydenburg districts. Government statistics are as follows:

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[22] Commerce Reports, "Russian platinum industry in 1927": Mar. 19, 1928, pp. 756–757.
[23] Economic Review of the Soviet Union: Vol. 3, No. 4, Feb. 15, 1928, p. 68.
[24] Bureau Foreign and Domestic Commerce, Foreign Trade Notes 179, Feb. 18, 1928, p. 2.
[25] Annual Report of the Secretary for Mines and Industries, Union of South Africa, 1926, pp. 36–37.

Production of platinum in the Waterberg and Lydenburg districts in 1926

	Quantity	Assay	Estimated contents platinum metals (ounces)
Crude platinum	11,582.169 ounces	75.25 per cent	8, 723. 300
Concentrates	172.789 tons	10.54 ounces per ton	1, 821. 903
			10, 545. 203

Sales of platinum metals amounted to 4,951.347 fine ounces, valued at £93,307.

Sales of osmiridium from South Africa during 1927 amounted to 5,197 ounces, valued at £54,197, and sales of platinum were 10,431 fine ounces, valued at £144,191.

The companies engaged in developing the platinum deposits of South Africa have developed large reserves of ore carrying from 3 to 8 pennyweights a ton but have found that extraction has not been as high as could be wished. As a consequence, much experimental work has been done in South Africa as well as in Europe and the United States on the metallurgy of these ores. So far the oxidized ores have not been treated with marked success. The sulphide ores are amenable to flotation concentration, followed by smelting, and recovery of the metal content from the matte, either chemically or by electrolytic methods. Costs have been rather high, and with the low prices of platinum metals prevailing during 1926 the outlook was not so hopeful as it is at the present time (April, 1928).

H. R. Adams [26] has given data on a palladium antimonide mineral found in the ore from the Tweefontein farm of the Potgietersrust Platinums (Ltd.). The mineral is silvery white with a specific gravity of 9.5. Chemically it consists of palladium (70.4 per cent), antimony (26 per cent), insoluble (1.4 per cent), and ferric iron (0.9 per cent). Sperrylite, the platinum arsenide, is also present in the ore. So far as the writer (J. M. Hill) knows, this discovery of a palladium antimonide mineral is the first on record.

A report of the Technical Committee of the Potgietersrust Platinums (Ltd.) [27] states that 23,709 tons of ore was treated at the Vaalkop flotation plant, which yielded 415.8 tons of concentrate carrying 6.31 pennyweights of platinum metals a ton and 31.6 tons of nickel and 13.9 tons of copper. Tailings carried 1.98 pennyweights of platinum metals. The ore was a mixed serpentinized dolomite and pyroxenite which required very fine grinding. The ore reserves at the Vaalkop and Zwartfontein farms are estimated at 300,000 tons, averaging 6 pennyweights of platinum metals a ton. Development at the Rustenburg holdings have not been so satisfactory, particularly in the southern town lands, where the reef was broken and carried low values. In the northern town lands the reef is regular and carries better values. In this area 7,440 feet of development on the reef indicates that the ore carries 3.5 to 5 pennyweights a ton over a stoping width of 36 inches. Various European companies have been experimenting with concentrates for the company. The Deutsche Gold & Silber Scheideanstalt quoted a charge of £192 a ton for matte treatment, equivalent to £27 a ton of ore; the Mond Nickel Co. quoted £27 10s. a ton for treatment of concentrates and guaranteed an extraction of more than an 80 per cent recovery of precious metals; and the Chemical & Metallurgical Corporation estimated it could save over 90 per cent of the precious metals at a cost approximately met by the value of nickel content of the concentrate.

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[26] Editorial, South African Mining Journal, vol. 38, July 9, 1927, pt 1, p. 554.

[27] South African Mining and Engineering Journal: Vol. 38, Dec. 24, 1927, pt. 2, p. 455. Mining Magazine (London): Vol. 38, Feb., 1928, p. 128.

The Lydenburg Platinum Areas report for the year ended June 30, 1927,[28] states that the test mill, which started in March, 1927, had treated 16,868 tons of ore and recovered a total of 3,560 ounces of platinum metals, of which 2,868 ounces were recovered as metallics. Sixty-nine tons of concentrates were produced, estimated to carry 692 ounces of platinum metals. Tabulation of reports published in the South African Mining and Engineering Journal show that from July to November, 1927, 14,469 tons of ore was milled, yielding 2,760 ounces of platinum.

The annual report of the Onverwacht Platinums (Ltd.) for the year ended October 28, 1927,[29] states that since November, 1926, the mill has been treating an average of 2,300 tons a month. The total tonnage treated in the fiscal year was 23,673 tons, from which 8,964 ounces of crude platinum was produced, equivalent to 7.572 pennyweights a ton. The recovery was 83.69 per cent. Losses in refining are estimated to be 1.97 ounces with a net recovery of 8,767 ounces. The cost of production of an ounce of mixed platinum metals is given as £5 8s. The company spent £90,782 and paid two dividends, amounting to 17½ per cent. There is a reserve of 47,000 tons of 7.4 pennyweight ore above the 400-foot level in the Onverwacht mines. Development on the 500-foot level has been disappointing, with lower values. The company plans to explore to the 800-foot level of the mine.

The Eerstegeluk Platinum Mines (Ltd.), owning properties in the Lydenburg and Rustenburg districts, is believed to be an important potential producer of platinum at relatively low costs. In the Rustenburg district 5,000 feet of development from three shafts to an incline depth of 400 feet has blocked large tonnages of 4 to 7 pennyweight ore over widths of 3 to 4 feet.[30] Large bodies are also said to have been blocked out in the Lydenburg district. It is reported [31] that this company has at least 9,000,000 tons of ore, 24 inches wide, that will carry 8 to 9 pennyweights of platinum metals a ton, of which 77 per cent is platinum and 15 per cent palladium. Estimated costs are £8 an ounce of platinum.

The Northern Platinum Exploration (Ltd.), in its annual report,[32] states that it has developed 700,000 tons of ore carrying 4.77 pennyweights of platinum metals over a width of 46.6 inches; 630,410 tons of the total is oxidized ore. The sulphide ore below a depth of 500 feet on the incline carries 4.2 pennyweights of platinum metals a ton. Values in the oxidized ore can not be saved economically by present known metallurgy, and the property is too far from transportation to warrant erection of a mill at present. Work was suspended August 16, 1927.

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[28] South African Mining and Engineering Journal: Vol. 38, Dec. 31, 1927, pt. 2, p. 465.
[29] South African Mining and Engineering Journal: Vol. 38, Nov. 5, 1927, pt. 2, p. 234.
[30] South African Mining and Engineering Journal: Vol. 38, May 21, 1927, pt. 1, pp. 319–324.
[31] South African Mining and Engineering Journal: Vol. 38, Dec. 10, 1927, pt. 2, p. 395.
[32] South African Mining and Engineering Journal: Vol. 38, Nov. 19, 1927, pt. 2, p. 300.

ANTIMONY

By J. W. Furness[1]

STATISTICAL SUMMARY

Summary of statistics for antimony in the United States, 1926–27

	1926	1927
Average price for year of antimony at New York . . . cents per pound	15.91	12.34
Imports for consumption:		
Antimony in ore . . . short tons	1,559	2,015
Metal . . . do	11,506	9,891
Exports of foreign antimony . . . do	184	363
Stocks of antimony in bonded warehouse at end of year . . . do	962	1,773
Production of antimonial lead (from domestic and foreign ores) . . . do	22,524	24,347
Antimony contained . . . do	2,693	2,736
Recovery of secondary antimony . . . do	16,230	12,400

INTRODUCTION

In 1927 there was apparently a falling off in the demand for antimony in the New York market, thus indicating a possible decrease in domestic consumption. During the year exports from China were equivalent to 65 per cent of the world's production. As China plays such a prominent part in supplying the world's demands for antimony, whatever affects China has an immediate world-wide reflection in the antimony industry. In China during 1927 there was a slight decline in the price paid by the consumer. Notwithstanding the increased export taxes, the production in China did not decrease greatly in 1927 as compared with that of 1925 and 1926. It is thus evident that despite the military operation at and near the centers of mining, production was not much affected. For several years prior to 1927 the increase in consumption of antimony in the United States was due in part to increased demand for battery grids used in the manufacture of storage batteries, and the decrease in 1927 was due in part to the curtailment of the demand for antimony in bearing metals. The rapid growth of the automobile and radio industries has played a large part in the consumption of antimony, but the recent introduction of "light-socket power" for use in radio receivers has curtailed consumption of storage batteries as well as dry batteries. On the other hand, an increased consumption of antimony in the rubber trade seems indicated. Vermilion red (artificial cinnabar) is used largely in the coloring of rubber, and when the gap between the price of mercury and antimony is sufficiently great antimony known to the trade as "antimony sulphurette" becomes the substitute.

There was no domestic production of antimony from domestic antimony ores in 1927. One of the developments of the year was the introduction of electrolytic antimony from Germany. Approximately 100 tons was imported. This metal is sold under a guarantee of 99.75 per cent metallic antimony, maximum 0.10 per cent arsenic, and commands a premium of 2 cents per pound on the market.

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The following is abstracted from an article appearing in the Engineering and Mining Journal, September 10, 1927, page 432:

> The Norddeutsche Affinerie of Hamburg, one of the large copper and lead refineries in Europe, is now producing regularly electrolytic antimony in commercial quantities.
>
> Following the electrolytic production of copper, aluminum, and zinc, antimony is undoubtedly the first of the minor metals to be produced in this manner. The recovery of antimony by electrolysis has opened up an entirely new field, as in this process the valuable metals contained in the ore, such as gold and silver, are recovered. At the same time there is produced antimony of a purity which it is difficult to duplicate by any other process of refining. Most of the buyers of antimony are desirous of obtaining the metal as nearly free as possible from such impurities as arsenic, bismuth, copper, and sulphur; and by the electrolytic method of refining, these impurities are reduced to traces or to such a fraction of a percentage that they do no harm in the ultimate product.

PRICES

Monthly prices of ordinary brands of antimony at New York in 1927, in cents per pound [1]

Month	Maximum	Minimum	Average	Month	Maximum	Minimum	Average
January	14.50	12.87½	13.92	August	12.12½	11.37½	11.78
February	15.12½	13.50	14.43	September	11.75	10.25	11.02
March	14.00	11.87½	12.83	October	11.37½	10.75	11.02
April	15.50	12.75	14.19	November	10.87½	10.37½	10.77
May	13.37½	12.25	12.81	December	11.62½	10.62½	11.13
June	12.87½	12.00	12.36				
July	12.25	11.50	11.83	The year	15.50	10.25	12.34

[1] Metal Statistics, 1928, American Metal Market.

During the first six months of 1927 the imports of antimony metal were slightly greater than those of the corresponding period of the previous year. With the decrease in consumption indicated, stocks gradually accumulated, resulting in a decrease in price. During the first six months the average price of ordinary brands at New York was 13.42 cents per pound; the highest monthly price during the year was 14.43 cents for February. The average price for the second half of the year was 11.26 cents per pound; the highest monthly price in that period was 11.83 cents for July. The year closed with a spot price of 10.875 cents per pound. The average price for the year was 12.34 cents per pound, duty paid, as compared with 15.91 cents in 1926.

The domination of China in the world situation in antimony has been repeatedly noted. Attention has been called to the apparent fact that at a price of 15 cents a pound, with a small marginal range, no country can compete against the low cost of production in China. The upper ranges of the price of antimony invariably bring forth latent production, which results in an excess supply and which invariably disorganizes the market. Before 1913 the monthly annual fluctuations in price of antimony were confined to a range of less than one-half cent, as illustrated by the years 1909 and 1910. In 1909 the price was highest, 7.57 cents, in January, and lowest, 7.11 cents, in March. In 1910 the price was highest, 7.50 cents, in

January, and lowest, 7.03 cents, in December. Before 1914 the price of antimony fluctuated greatly only during major international disturbances. These fluctuations were due in part to the rapid increase in consumption caused by war needs. In peace times, however, the domestic consumer was assured of his supply and purchased his requirements as needed. Thus, whatever speculative risk existed was borne by the producer and distributor. But since the beginning of the World War prices have fluctuated greatly because of the resultant pressure brought upon the world's production of antimony. As an example, in 1915 the highest average monthly price, 39.36 cents, was in December and the lowest, 15.24 cents, in January. In 1916 the highest average monthly price, 44.71 cents, was in March and the lowest, 11.57 cents, in September.

Since 1922 the world situation regarding the production of antimony has become more widely known, and especially since 1924 when, at the request of domestic antimony importers and consumers, official reports bearing on current market conditions in China were made available to the trade. Consequently, there has been a return to pre-war conditions, which has resulted in a growing feeling of confidence by the domestic consumer that his needs will be supplied and that there is no real necessity of purchasing large stocks to tide over crises that might occur in China or elsewhere. During the war period the consumer had to assume, by the force of conditions, any financial risk due to wide fluctuations in price. It appears that the present method of buying has reverted to the pre-war practice and once again passed to the importer and distributor the major part of the speculative risk attendant upon the handling of antimony.

PRODUCTION

There was no domestic production of antimony ore in 1927, but domestic lead ores yielded a considerable tonnage of antimony-lead alloy, 10 per cent antimony and 90 per cent lead, as a by-product of lead smelting, and foreign ores yielded an additional quantity of similar by-product. This material was used as a substitute for antimony in making bearing metal, type metal, etc. The production of antimonial lead from domestic ores was 16,040 tons, with an antimony content of 1,996 tons. The recovery of antimony from old alloys, scrap, and dross was 12,400 short tons.

The world's estimated production of metallic antimony for 1927 was, in round numbers, 29,000 short tons. The total quantity of metallic antimony and liquated antimony sulphide imported for consumption in the United States was 10,968 short tons. In addition to the imports of metallic antimony and antimony sulphide, 439 tons of type metal and antimonial lead containing 106 tons of metallic antimony, 1,803 tons of antimony oxides and other compounds, and 3,566 tons of antimony ore containing 2,015 tons of antimony were imported for consumption.

Mine production of antimony ores in the United States, 1918–1927, in short tons

Year	Ore	Antimony content	Year	Ore	Antimony content
1918	190	50	1924	113	33
1919–1921			1925	123	33
1922	20	4	1926	99	43
1923	40	10	1927		

SMELTER PRODUCTION OF ANTIMONIAL LEAD

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1918–1927

Year	Short tons	Antimony content		Year	Short tons	Antimony content	
		Short tons	Value [1]			Short tons	Value [1]
1918	18, 570	2, 566	$647, 000	1923	14, 190	2, 170	$338, 500
1919	13, 874	1, 943	319, 000	1924	20, 787	2, 763	596, 800
1920	12, 535	2, 033	345, 000	1925	19, 667	2, 624	918, 400
1921	10, 064	1, 589	158, 000	1926	22, 524	2, 693	856, 400
1922	8, 075	1, 441	156, 000	1927	24, 347	2, 736	675, 800

[1] Calculated at average yearly price for ordinary brands of antimony as given by American Metal Market.

RECOVERY OF SECONDARY ANTIMONY

During 1927 (according to J. P. Dunlop) the recovery of antimony from old alloys, scrap, and dross was 12,400 short tons. Of this total 10,700 tons were recovered in the form of alloys and 1,700 tons as metallic antimony; 1,039 tons were recovered from antimonial lead scrap treated at regular smelters, and 11,361 tons were recovered as metal and in alloys at secondary smelters.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1918–1927

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1918	5, 226	$1, 317, 000	1923	8, 021	$1, 252, 800
1919	4, 399	717, 900	1924	9, 404	2, 025, 600
1920	5, 600	938, 560	1925	10, 840	3, 794, 000
1921	4, 720	464, 400	1926	16, 230	5, 164, 400
1922	7, 090	765, 700	1927	12, 400	3, 060, 300

[1] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

IMPORTS AND EXPORTS

Antimony imported for consumption in the United States, 1918–1927

Year	Antimony ore [1]			Liquated antimony sulphide [2]		Metallic antimony [3]		Antimony oxides and other compounds [4]	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1918	3, 363	1, 425	$177, 731	833	$113, 258	14, 011	$3, 065, 619	18	$11, 904
1919	993	409	54, 477	278	19, 202	7, 159	1, 021, 587	126	9, 501
1920	1, 709	682	70, 285	1, 375	123, 902	9, 817	1, 216, 376	298	25, 260
1921	213	98	11, 682	353	17, 577	10, 130	784, 146	154	15, 558
1922	----------	----------	----------	689	40, 108	9, 344	659, 242	379	65, 538
1923	(5)	1, 047	44, 721	835	64, 493	6, 763	641, 804	2, 277	288, 206
1924	(5)	899	62, 999	558	52, 393	6, 778	840, 434	1, 207	190, 252
1925	1, 359	773	47, 084	760	115, 990	9, 857	2, 362, 915	1, 792	349, 990
1926	2, 497	1, 559	287, 258	2, 040	343, 705	11, 506	3, 144, 330	2, 259	517, 584
1927	3, 566	2, 015	282, 098	1, 077	134, 949	9, 891	2, 111, 411	1, 803	484, 873

[1] Classified in tariff classification as "Antimony ore and stibnite containing antimony."
[2] Classified in tariff classification as "Antimony matte containing not more than 10 per cent of lead," also as "needle or liquated antimony."
[3] Classified in tariff classification as "Antimony regulus or metal."
[4] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."
[5] Figures not available.

Antimony imported into the United States, 1926–27 [1]

[General imports]

Country	Antimony ore			Antimony metal [2]	
	Gross weight (short tons)	Antimony content			
		Short tons	Value	Short tons	Value
1926					
Africa—Belgian Congo	27	14	$2, 366		
Argentina	138	115	9, 185		
Belgium				98	$25, 152
Bolivia [3]	218	130	20, 996		
Brazil	26	16	2, 111		
Canada	71	34	3, 250	(5)	40
Ceylon				28	4, 900
Chile [3]	847	528	70, 919		
China [4]				11, 432	2, 903, 294
France				398	93, 669
Germany				1, 671	441, 329
Hong Kong [4]				56	14, 856
Italy				17	307
Japan [4]				64	20, 921
Kwantung				56	16, 137
Mexico	1, 222	751	181, 438	66	14, 806
Netherlands				196	40, 320
United Kingdom	[6] 2	2	593	629	219, 361
	2, 551	1, 590	290, 858	14, 711	3, 795, 092
1927					
Argentina	91	49	5, 385		
Austria				83	19, 124
Belgium				22	5, 948
Bolivia [3]	28	17	2, 725		
Canada				(5)	47
Chile [3]	1, 880	1, 159	108, 082		
China [4]				9, 900	1, 948, 474
France				97	23, 241
Germany				1, 054	227, 927
Greece	36	20	943		
Japan [4]				34	8, 091
Mexico	1, 429	710	157, 304	564	116, 246
Netherlands				84	19, 462
Peru	47	27	3, 909		
United Kingdom				532	147, 791
	3, 511	1, 982	278, 348	12, 370	2, 516, 351

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[1] Includes large quantities of antimony metal that went into bonded warehouse and that are not included in the table of imports for consumption.

[2] Includes small quantities of liquated antimony sulphide, known in the trade as "crude antimony," "antimony matte," or "needle antimony."

[3] Imports credited to Chile originated mainly in Bolivia.

[4] Nearly all the imports of antimony ore and metal from Hong Kong and Japan are of Chinese origin. Some of the material credited to other countries is possibly also of Chinese origin, having been transshipped in a foreign port.

[5] Less than 1 ton.

[6] As recorded by Bureau of Foreign and Domestic Commerce; probably metal.

Type metal [1] *imported for consumption in the United States, 1918–1927*

Year	Type metal		Assumed antimony content		Year	Type metal		Assumed antimony content	
	Short tons	Value	Short tons	Percentage		Short tons	Value	Short tons	Percentage
1918	276	$35, 938	19	7. 0	1923	[2] 3, 677	[2] $431, 610	(3)	(3)
1919	6, 697	816, 642	1, 197	17. 9	1924	[2] 644	[2] 100, 367	(3)	(3)
1920	14, 944	1, 349, 495	2, 063	13. 8	1925 [1]	3, 005	463, 134	850	28. 3
1921	19, 485	1, 191, 553	4, 132	21. 2	1926 [1]	4, 311	912, 331	784	18. 2
1922	22, 448	1, 120, 814	5, 476	24. 4	1927 [1]	439	65, 049	106	24. 1

---

[1] Classification for 1925 to 1927 is "Type metal and antimonial lead"; separate figures not recorded.

[2] Lead content only. Figures for gross weight for 1923 and 1924 not available.

[3] Data not available.

Foreign antimony (matte, regulus, or metal) exported from the United States, 1918–1927 [1]

Year	Short tons	Value	Year	Short tons	Value
1918	705	$164,666	1923	8	$1,047
1919 [2]	215	33,913	1924	140	14,441
1920	448	51,607	1925	94	17,376
1921	150	15,741	1926	184	41,554
1922	19	1,548	1927	363	72,280

[1] During 1922 there was also exported, mainly to Canada, 112 tons of regulus or metal of domestic manufacture, valued at $13,961. This is the first export of domestic antimony of which there is any record. However, antimony manufactured in the United States from foreign ores and exported would also be classed as domestic exports. Similar exports for 1923–1927 are not shown.

[2] Also 3 short tons of antimony ore, containing 5,380 pounds of antimony, valued at $1,665, was exported in 1919.

CONSUMPTION

The increase in per capita consumption of metals during the past 20 years has brought to those engaged in their production a realization of the rapidity with which the world resources are being drawn upon. Many of the metals are used for purposes that render them of slight service to humanity in point of time, and as a rule are thus so dissipated that their recovery or reclamation becomes a problem which seems at present to have no solution—for example, metals and metallic salts used in pigments, such as lead in white lead; magnesia used as a flashlight; iron, steel, and other metals dissipated by corrosion, friction, or abrasive action. In the utilization of metals the percentage of uses that dissipate them varies widely for the different metals. Accurate figures representing such losses are unknown, unfortunately, and difficult to obtain.

Unalloyed antimony is used but little in the trade. The relation of antimony to lead in commerce is so intimate that whatever affects lead reacts on antimony. Approximately 900,000 tons of lead represents the annual domestic consumption. Of this amount it has been estimated that in 1926, 190,000 tons was utilized in antimonial lead for storage batteries; 180,000 tons in cable sheathings which contain some antimony; 120,000 tons as white lead. Thus 54 per cent of the total consumption is represented by these three uses. Antimony and lead used in the storage-battery industry are not dissipated. The battery plates after rendering their service are reclaimed and 90 per cent of the antimony and lead again finds its way into the market and may be used and reused many times. The antimony and lead required in the manufacture of cable sheathings are not dissipated by this use, but they do not find their way rapidly into the reclaimed metal market. The metals thus used form, temporarily at least, a reservoir from which lead and antimony may be drawn on at almost any time in the future. Lead used as white lead in paint, etc., gives but a short service, and when so used it is lost beyond recovery.

The toxic characteristics of antimony as a pigment are not similar to those of lead, against the use of which strong action is being taken in Europe. So there is no evidence that any curtailment of the consumption of antimony by this use will be effected by drastic regulation.

The present situation as to the available supply of antimony from reclaimed material presents an interesting picture. In 1926 the general imports of metallic antimony, including antimony contained in ore, were 16,301 short tons, and production of secondary antimony amounted to 16,230 tons (antimony content), a difference of only 71 tons. The four major uses of antimony (antimonial lead alloys) are in the manufacture of battery plates, babbitt metal, soft metal alloys and solder, and hard lead including pipes, taps, etc. These uses consume approximately 72 per cent of the total utilized. Relatively all the metal used in these industries is recovered except that used in the manufacture of solder; little of this is recovered. Less than 4 per cent of the total virgin antimony required by the domestic trade, however, is utilized for this purpose. The major part of the antimony required in the manufacture of type and type metal, bearing or antifriction metal, cable coverings or sheathings, brass (including bronze), etc., is recoverable; only a small part of the antimony utilized in the manufacture of vulcanized rubber and rubber goods, enamels on metal ware, chemicals, paints and pigments, shrapnel and other bullets, foil, collapsible tubes, lighting fixtures, primers for explosives, etc., can be reclaimed. A part of the antimony utilized in babbitt metal, battery plates, type metal, etc., may come into service several times during a year, thus in part offsetting the withdrawal from market of the material tied up in cable sheathings, etc. Possibly because of the increased consumption of antimony used in battery grids in the past few years, the percentage of metal recovered as compared with virgin metal utilized has been ever increasing, thus rendering available for reclamation larger amounts of antimony. The slowing up of the automobile industry in 1927 may constitute a factor whereby the percentage of recovered metal in 1928 will be very much greater in proportion to the virgin metal used than it has been in the past few years.

A natural inference is that the larger part of the metal recovered in any one year finds its way on the market in the ensuing year. The percentage of recoverable metal also varies with the price fluctuations of virgin metal. In most of the metals that are recovered domestically, the percentage of recovered metal to virgin metal produced or imported was very much greater during the year 1921 than in the preceding or following years because of world-wide depression in the market for virgin metals.

In Technical Publication No. 97 of the American Institute of Mining and Metallurgical Engineers, Nonferrous Secondary Metals Recovered in the United States, by J. P. Dunlop, the following appears:

> The total value of the secondary metals included in the inquiry during the period 1910–1926 has been about $2,773,000,000, about $726,000,000 more than the combined value of the gold and silver production in the same period.
>
> With industrial expansion and greater consumption of primary metals the recoveries of waste will increase, for large companies with adequate equipment and with widely distributed plants and agencies now handle the bulk of metal wastes. Buying in large quantities and employing chemists and metallurgists, they use materials to the best advantage and sell metals and alloys on close specifications or by brands.
>
> Business ethics of the trade have improved, and rigorous competition has caused expansion in the size of plants and in the reliability of their products, so that there are few users of metals who can afford to ignore the saving possible by the use of some reclaimed material.

The part to be played by reclaimed metals in future consumption is indicated by the ratio of reclaimed antimony to virgin consumption. The rapid growth of the reclaimed metal industry indicates a basicly sound method of conservation. If the proper definition of conservation as applied to metals is judicious exploitation and utilization, the reclamation industry is one of the chief contributors toward conservation. Reclamation and the tendency to replace certain uses of metals by organic substances are the chief assurances of adequate supply of metals at reasonable price for future uses. Examples of the replacement of metal by organic materials are fiber-asphalt conduits coming into use in place of lead and antimony-lead alloy conduits, and organic pigments being used for inorganic pigments.

WORLD SOURCES

World's production of antimony, 1919–1927, in metric tons [1]

[Compiled by L. M. Jones, of the Bureau of Mines]

Country [2]	1919	1920	1921	1922	1923	1924	1925	1926	1927
North America:									
Canada	[3] 14	--------	--------	--------	--------	--------	--------	--------	--------
Mexico	471	623	45	464	490	775	1,398	2,614	1,924
United States	--------	--------	--------	4	8	24	24	31	--------
South America:									
Argentina	[4] 27	[4] 50	--------	[3] 1	[3] 5	[4] 120	[3] 10	[4] 158	(5)
Bolivia [3]	105	484	282	185	312	621	1,384	3,503	3,214
Peru	[3] 30	[3] 7	--------	--------	--------	--------	8	47	58
Europe:									
Austria	1	--------	--------	139	62	1	--------	87	857
Czechoslovakia	153	330	384	100	453	1,066	535	938	(5)
France	998	1,130	1,276	834	691	1,021	648	580	658
Germany (Bavaria)	--------	--------	2	4	(5)	(5)	(5)	--------	--------
Greece	55	46	--------	--------	--------	--------	--------	--------	(5)
Hungary	66	93	--------	--------	--------	--------	--------	--------	(5)
Italy	10	187	76	146	271	372	312	360	285
Portugal	--------	--------	--------	--------	8	14	15	--------	--------
Spain	--------	--------	--------	--------	25	--------	--------	14	10
Yugoslavia	(5)	(5)	(5)	(5)	131	414	139	182	279
Asia:									
China [3]	7,721	13,001	14,658	13,858	14,256	12,059	19,496	20,028	17,211
India, British	2	(6)	1	--------	--------	--------	5	53	(5)
Japan	1	--------	--------	--------	--------	10	--------	--------	(5)
Turkey (Asia Minor) [7]	400	400	400	400	400	400	400	400	400
Africa:									
Algeria [3]	723	1,000	103	579	500	905	1,461	334	442
Morocco, Spanish	--------	--------	--------	--------	--------	--------	--------	[3] 70	(5)
Nigeria [3]	(8)	(8)	(8)	(8)	(8)	--------	--------	--------	--------
Rhodesia, Southern	--------	2	--------	--------	--------	--------	5	7	--------
Union of South Africa	10	--------	--------	--------	--------	--------	--------	--------	(5)
Oceania:									
Australia—									
New South Wales	70	81	50	--------	--------	--------	12	34	(5)
Queensland	--------	--------	--------	--------	--------	--------	--------	3	2
Victoria	491	406	141	605	421	130	54	--------	--------
Western Australia [3]	--------	(9)	--------	--------	--------	--------	--------	(9)	(5)

[1] Approximate recoverable metal content of ore produced, exclusive of antimonial lead ores.

[2] In addition to the countries listed, antimony ore is reported produced in Siam and Chosen, as follows: Siam, 9 tons of ore in 1924; Chosen, 21 tons of ore in 1926. As no information is available on the antimony content of these ores, the figures have not been included in the table.

[3] Exports.

[4] Railway shipments. A large part of the shipments reported is probably of Bolivian origin and therefore may duplicate in part the quantities shown for Bolivia.

[5] Data not available.

[6] Estimated recovery from ore produced, 2 kilograms.

[7] Estimated.

[8] Less than 1 ton. The estimated recoverable metal content of ores exported was as follows: 1919, 169 kilograms; 1920, 178 kilograms; 1921, 74 kilograms; 1922, 190 kilograms; 1923, figures not given.

[9] Less than 1 ton. Estimated recoverable metal content of ores exported was as follows: 1920, 278 kilograms; 1926, 464 kilograms.

BOLIVIA

In 1927 the exports of antimony ore from Bolivia aggregated 6,718 metric tons, containing 4,017 metric tons of metallic antimony. The greater part of these exports went to Great Britain and Belgium. Smaller amounts were shipped to the United States, France, Argentina, and Germany.

CANADA

The Bureau of Provincial Information of New Brunswick reported that the antimony mines at Lake George, York County, New Brunswick, were to resume work in September of 1927. A concentrating plant had been installed; the concentrates are to be shipped to a chemical factory and the hand-sorted high-grade ore is to be shipped to the United States.

CHINA

The antimony situation in China during the year 1927 was given in an article prepared by the Minerals Division and published in Commerce Reports, January 16, 1928, pages 164–165, as follows:

Despite military operations at and near the center of production, increased export taxes, and the decline in the price paid by consumers in 1927, it is evident that the output of antimony in China did not decrease during the year as compared with 1925 and 1926. Exports apparently were less than in 1926. The exact tonnages warehoused are unknown.

Exports from Changsha recorded by Maritime Customs.

"Exports" of antimony from Changsha, as reported by the Maritime Customs, are indicative of the total Chinese production, since the Province of Hunan easily accounts for over 95 per cent of the entire output of the country. (It has been estimated that Hunan contributes 85 per cent of the total world production.) Although some stocks were maintained at Changsha, during 1927 most of the material warehoused was held by merchants in Hankow or Shanghai. Chinese consumption for the year is unknown, but the figure is insignificant as compared with the tonnage shipped abroad.

According to the Maritime Customs the exports of antimony from Changsha during recent years were as follows:

Exports of antimony from Changsha according to the Chinese Maritime Customs

Item	1924	1925	1926	1927
	Long tons	*Long tons*	*Long tons*	*Long tons*
Regulus	11, 142	15, 465	16, 658	17, 324
Crude	1, 798	2, 865	3, 348	2, 653
Oxide			1, 750	1, 597

The term "exports," when applied to those from Hunan, is used to designate shipments of antimony from Changsha to Hankow, Shanghai, and all foreign ports.

No definite information regarding stocks of antimony on hand at Changsha on January 1, 1927, is available. Reports from the American consulate, however, indicated that 900 long tons were held at that port on that date.

Hankow supplants Changsha as center of trade.

In 1925 it is estimated that 80 per cent of the antimony trade of Changsha was in the hands of foreign firms. In 1926 the Chinese did 60 per cent of the business, and conservative estimates for 1927 indicate that over 75 per cent of the trade was controlled by Chinese. As a consequence, during last year Hankow, although not a production point, definitely supplanted Changsha as the center of the antimony exporting trade of China.

Some shipments are consigned to Shanghai from Hankow, but the largest proportion of antimony "exported" from this port is manifested for direct foreign trade.

The following table shows the quarterly flow of regulus from Hankow, the major distributing point of the Chinese trade in this metal:

Chinese antimony regulus exported from Hankow, China, in 1927, by quarters and by destinations

Destination	Pounds	Value
January-March:		
Shanghai	3, 991, 333	$380, 458
Japan	22, 400	2, 016
Total for first quarter	4, 013, 733	382, 474
April-June:		
Shanghai	2, 277, 333	191, 641
France	392, 000	32, 925
Germany	848, 933	71, 877
Great Britain	224, 000	18, 745
Netherlands	683, 200	56, 773
Total for second quarter	4, 425, 466	371, 961
July-September:		
Shanghai	3, 264, 267	297, 935
France	134, 400	11, 190
Germany	604, 800	50, 119
Great Britain	78, 400	6, 621
Italy	44, 800	3, 220
Netherlands	236, 267	17, 905
Total for third quarter	4, 362, 934	386, 990
October-December:		
Shanghai	3, 066, 134	231, 562
Japan	22, 400	2, 016
France	772, 800	62, 025
Germany	1, 756, 133	143, 731
Great Britain	642, 933	50, 622
Holland	1, 602, 667	123, 984
Italy	67, 200	4, 830
Total for fourth quarter	7, 930, 267	618, 770
Grand total for year	20, 732, 400	1, 760, 195

The article quoted on page 47 continues as follows:

Declared exports to the United States.

Declared exports of antimony to the United States from Hankow, Shanghai, and Changsha during 1926 and 1927, according to the records of the American consulates, were as follows:

Declared exports of antimony to the United States from Hankow, Shanghai, and Changsha

Item	Hankow		Shanghai		Changsha		Total	
	1926	1927	1926	1927	1926	1927	1926	1927
	Long tons	*Long tons*	*Long tons*	*Long tons*	*Long tons*	*Long tons*	*Long tons*	*Long tons*
Regulus	7, 027	4, 993	2, 224	2, 063	425	--------	9, 676	7, 056
Crude	915	319	503	376	160	--------	1, 578	695
Oxide	796	266	213	--------	25	--------	1, 034	266

Industry experienced many difficulties during year.

Although the output last year was not diminished, handicaps to antimony production in the Hunan region were present almost constantly. Since July, 1926, the increase in the wages of laborers, commandeering and interruption of traffic by the military, and imposition of new and additional taxes have tended to affect the Hankow price. Practically all of the mines in Hunan employ the old Chinese method of production, as do the smelters—the outstanding exception being the Tang mine at Yiyang.

Producers generally experienced difficulty during the third quarter of the year in obtaining foreign chemicals required in the purification of their product and many smelters, for the time being, used inferior Chinese substitutes. As a result, antimony regulus less than 99 per cent pure made its appearance on the market, and it is estimated that 2,000 to 3,000 tons of the inferior grade were placed abroad before it was discovered to be below standard. This condition has been corrected, and since October no regulus below the 99 per cent grade has been produced for export. Reports were circulated in the Changsha-Hankow district to the effect that in South America and England regulus of an extremely fine and uniform quality was being produced, and that the material was receiving the favor of American trade to the detriment of the Chinese product. Both factors, which may have been partially responsible for the slackening of American trade toward the end of the year, have caused producers considerable anxiety.

Smaller monthly production estimated for Hunan Province.

On December 31, 1927, approximately 600 tons of antimony were reported on hand at Hankow and 1,400 tons at Changsha. Stocks at Shanghai have not been announced. Production in the Hunan Province at the end of 1927 was estimated at the rate of 400 tons monthly, which, if correct, shows a noticeable decline in the rate prevailing earlier in the year. Shipments from Changsha to Hankow are somewhat irregular owing to military operations in this region.

FRANCE

The production of antimony ore in France in 1927 was 3,290 metric tons, as compared with 2,900 metric tons in 1926. The larger part of France's consumption of antimony is now derived from her possessions in northern Africa.[2]

MEXICO

The production of antimony in Mexico during the year 1927 was 1,924,115 kilograms, as compared with 2,614,444 kilograms in 1926, or a decrease of 26.4 per cent.[3]

The governmental regulations with regard to taxation and the legislative activities have made it difficult for even the strongest companies to continue operations. The Federal and State tax [4] on the value of antimony under the decrees of April 29, 1927, and August 12, 1927, are as follows: On natural minerals, concentrates, and other nonmetallic forms, 1 per cent; on impure bars, 0.9 per cent; on refined bars, 0.8 per cent.

The State of Sonora produces slightly more than one-third of the total production of Mexico. The most productive area of this State is the Altar district, in the municipality of Caborca. The principal mines are more than 115 miles from Santa Ana, a station on the Southern Pacific Railroad, 70 miles south of the international boundary. The mineralized area covers about 35 square miles. The principal deposits are found in veins. The antimony occurs as oxides, senarmontite (Sb_2O_3), and stibiconite ($Sb_2O_4 \cdot H_2O$), associated with small amounts of gold and silver. During the years 1915 to 1919 the mines were active. From 1920 to 1924 no production was made. In 1925 the production was approximately 170.5 short tons metallic content; in 1926, 902 tons; and in 1927, 695 tons.[5]

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[2] Masuret, Eugene A., clerk to trade commission, Official Provisional Figures Showing Production of Various Minerals in France in 1927, Including Potash: Paris, France, Sp. Rept. 10, No. 10, No. 64194, Feb. 24, 1928. Official provisional monthly statistics supplied by the Direction des Mines, Ministère des Travaux Publics.

[3] Bol. Minero: Vol. 25, No. 3, p. 204, Mexico City, Mexico, March, 1928.

[4] Altaffer, M. W., American consul, Nogales, Sonora, Mexico, Cons. Rept. 263986, Oct. 18, 1927.

[5] Altaffer, M. W., American consul, Nogales, Sonora, Mexico, Cons. Rept. 277841, Apr. 13-18, 1928.

MERCURY

By J. W. Furness [1]

STATISTICAL SUMMARY

Summary of statistics for mercury in the United States, 1926–27

[Flasks of 75 pounds, except as indicated]

		1926	1927
Production	flasks	7,642	11,276
Number of producing mines		17	26
Average price per flask:			
San Francisco		$91.60	[1] $117.61
New York		$91.90	[1] $118.16
London		£15 13s. 6d.	[1] £21 7s. 11d.
Imports for consumption	pounds	1,948,170	1,515,535
	equivalent in flasks	25,976	20,207
Exports	pounds	8,668	(2)
	equivalent in flasks	116	(2)
Stocks in warehouse at end of the year	flasks	2,277	5,736

[1] Price per flask of 76 pounds.

[2] Not separately classified for 1927.

INTRODUCTION

The average quoted price of mercury at San Francisco during 1926 was $91.60 per 75-pound flask (unless otherwise specified, the flask used in this report is the flask of 75 pounds). In 1927 there was a gradual increase in price from an average of $100 per 75-pound flask in January to $129 per 76-pound flask in December, a rise of 28 per cent during the year. The basis for price quotations was changed in the last week in June, 1927, from the 75-pound flask to the 76-pound flask. The number of producing mines was greater at the close of 1927 than in any year since 1911 with the exception of the World War period. It is of interest to note that in 1874 the lowest price reached was $91.80 at San Francisco as compared with the average price in 1926 of $91.60 and that in 1877 the peak of domestic production was reached.

The increased domestic production in 1927 was in the main due to the production of Oregon. In California, Idaho, Nevada, Oregon, and Washington prospecting was active. In California many of the old mines were partly revived, and in Idaho a relatively virgin area from which there has been little production, due possibly to its inaccessibility, was being developed. With the exception of the Opalite mine in Oregon no new large discoveries were made. Two companies in Nevada recovered 226 flasks of mercury from old gold and silver mill tailings in 1927. The Bureau of Mines classes such recovery as secondary; that is, mercury that has been in use before and has been taken into statistical account as production in some earlier year. Consequently, the 226 flasks are not included in the 11,276 flasks shown as the country's total production for 1927. The decrease in imports of mercury in 1927 was largely offset by the increase in domestic production.

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[1] Figures on domestic production compiled by H. M. Meyer and those on imports and exports, from records of the Bureau of Foreign and Domestic Commerce, by J. A. Dorsey, both of the Bureau of Mines.

In the past, when the price of mercury became abnormally high rapid substitution for many of its uses took place, and by lack of demand the price receded. Whether history will repeat itself may depend largely upon the finding of substitutes for the newer uses, such as the generating of power by mercury vapor.

The utilization of mercury vapor for power generation indicates a way to eliminate a portion of the waste which inevitably accompanies power generated by steam. In 1923 the General Electric Co. provided a construction-steam-mercury vapor plant for the Hartford Electric Light Co., at Dutch Point, Conn., generating 5,000 hp. and requiring 2,800 pounds of mercury. In 1927, after about four years of operation, the Hartford Electric Light Co. placed an order with the General Electric Co. for the installation of additional similar equipment including a 10,000-kilowatt mercury-vapor turbine requiring a charge of about 13 pounds of mercury per kilowatt capacity. Besides the 10,000 kilowatts from the mercury turbine the steam produced, if used in the best way, would give about 1,200 additional kilowatts. The new plant differs from the old in that the steam will be generated at 250 to 300 pound pressure and superheated by the mercury boiler furnace to an ultimate temperature of 700° F. It is estimated that 10,000 kilowatts will be obtained from the steam generated by the condensation of the mercury used in the steam turbine now operating. The original plant generated mercury vapor at 884° F. at 70-pound pressure.

Normally the increase each year in generator capacity in the United States is about 2,000,000 kilowatts. If the mercury system were generally adopted, this would call for 670,000 kilowatts of mercury turbines, requiring 8,700,000 pounds of mercury.

In the April 12, 1927, issue of Power, page 558, the following statement was made editorially:

> At present it appears that the cost of the mercury unit which seems to be some $200 per kilowatt entails high fixed charges, so that its use can be urged only where the return, in kilowatt hours per year, is high.

Owing to the large capital investment represented by the present steam power installations, it does not seem probable that these plants will be replaced, except very slowly, by the adoption of the mercury-vapor boiler.

In discussing the mercury industry and its relation to the Emmet Power System, A. C. Spencer, of the United States Geological Survey, said:

> The question as to the probable requirements of mercury may be approached by way of statistics showing the past and present status of the power industry in the United States. These statistics show that central station capacity has increased more rapidly than total power capacity and from this relation it follows that the capacity of prime movers installed at manufacturing and mining plants has formed a decreasing proportion of the total and that the field from which the new system must draw its customers is that of the central power plant.

Spencer states further:

> The capacity of central power stations in the United States is believed to be not far from half of the world at large.

Dr. W. L. R. Emmet, chief consulting engineer, General Electric Co., at a meeting of the Propeller Club, predicted the use of mercury in vapor boilers for ocean freighters. He stated that the Sun Oil Co., after a series of experiments with mercury-vapor boilers in its refineries, has decided to build a tanker with 3,000 to 4,000 horsepower to be developed by means of mercury vapor. He figured that it would be possible to install mercury-vapor machinery in a vessel like the *Mauretania* in about one-third of the present machinery space at about one-half the cost of a steam-turbine plant and with a saving of about $800,000 a year over fuel costs [2] under the present system of operation.

The development of the idea of using mercury vapor as a means of power has been an incentive for research along the lines of obtaining a substitute for this metal. Diphenyl oxide, a by-product in the manufacture of carbon tetrachloride and chloroform, seems to bid fair to compete with or supersede mercury vapor for the use mentioned.

During the past few years there has been an increased demand for manufactured cinnabar for use in coloring rubber products. The British Dyestuff Corporation has recently issued a booklet, the fourth of a series on rubber products, giving full details of the dyes for rubber and useful notes concerning the uses and application. The use by this corporation of what are termed Vulcafor colors, which are organic dyes, indicates the direct substitution of such organic pigments for sulphides of mercury or antimony, oxides of lead, and other oxides of certain metals.[3]

Requirements for mercury for manufacturing dry cells illustrate the small consumption of the metal to satisfy this demand. According to Camp,[4] in the manufacture of 1,500,000 No. 6 dry cells 75 pounds of mercury—practically equivalent to one flask—is required. Mercuric chloride is added to the electrolyte to form a protective coating on the inside of the zinc container, the mercury in the mercuric chloride amalgamating with the zinc.

Taking into consideration the increased world production of mercury and the increased capacity for production as indicated by the Almadén mine of Spain, there seems little evidence of a world shortage. It seems evident, judging from the past history of this industry, that the domestic consumer will in the future depend even more largely than in recent years upon foreign imports for his needs. During the last few years there has been little production from domestic deposits of high-grade mercury ore. The occurrences of low-grade deposits are fairly well known. Considering the size of these low-grade deposits it would seem reasonable to assume that the output from these sources will be small as compared with the former output of the New Idria mine and the New Almadén mine of California. It has been held that the domestic mercury production has been curtailed by a strictly limited demand and that price has had little to do with the extent of its use. These statements are not substantiated by the record of past production, imports, and price.

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[2] American Metal Market, Jan. 21, 1928, pp. 3–5.

[3] Chemical Age, Feb. 19, 1927, p. 183.

[4] Camp, A. D., "Chemical Raw Materials for Dry Cell Industry": Chem. and Met. Eng., vol 305, No. 3, March, 1928, p. 155.

The increased demand for mercury, as indicated in the early history of gold mining, was met by increased production and increased price. The increased demand in such uses as the coloring of rubber and in the ceramic industry where the pigment vermilion red is used has invariably been met in the past by substitution at price by such materials as antimony sulphurette and organic coloring matters, indicating that in these uses price limits consumption. From the point of view of Europe the mercury industry is marked by an endeavor to increase output. In northern Africa, in the Ras El Ma mine, intensive prospecting has been carried on. In Germany it is rumored that such districts as those of Kirchheimbolanden and mines near Moersfield am Appeltal may be reopened.[5] These activities are possibly due to the report that an agreement between the producers of the Almadén (Spanish) mines and the Idria (Italian) mines provides for the stabilization of sales and the control of prices.[6]

DOMESTIC PRODUCTION

The production of mercury in the United States in 1927 amounted to 11,276 flasks, valued at $1,314,782; in 1926 it was 7,642 flasks, valued at $702,323. Thus, there was an increase in quantity of nearly 48 per cent and an increase in value of 87 per cent. The production of 1927 came from 9 mines in California, 8 in Nevada, 3 in Oregon, 3 in Texas, and 1 each in Arizona, Washington, and Alaska, a total of 26 producing mines. Figures showing the average tenor of the ore treated in 1927 are not obtainable because of the large quantity of dump material treated with the ore for which separate figures are not available. The average tenor in 1926 was 0.54 per cent.

Mercury produced in the United States, 1918–1927

	Producing mines	Flasks of 75 pounds	Value
1918	47	32,883	$3,863,752
1919	34	21,415	1,933,560
1920	17	13,392	1,066,807
1921	11	6,339	300,595
1922	10	6,375	368,348
1923	14	7,937	521,302
1924:			
California	6	7,966	547,185
Texas, Nevada, Arizona, Oregon, and Idaho	7	2,119	145,554
	13	10,085	692,739
1925:			
California	7	7,614	632,936
Texas, Nevada, Arizona, and Idaho	6	1,560	129,680
	13	9,174	762,616
1926:			
California	7	5,726	$526,237
Idaho	1	6	551
Nevada	4	197	18,105
Washington	1	489	44,941
Texas, Alaska, and Arizona	4	1,224	112,489
	17	7,642	702,323
1927:			
California	9	5,748	670,217
Nevada	8	425	49,555
Oregon	3	2,082	242,761
Washington	1	566	65,996
Texas, Alaska, and Arizona	5	2,455	286,253
	26	11,276	1,314,782

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[5] American Metal Market, Jan. 13, 1928, p. 5.

[6] American Metal Market, Feb. 9, 1928, p. 5.

PRICES

Average yearly prices of mercury in the United States and the United Kingdom, 1914–1927

[Per flask of 75 pounds, except as indicated]

Year	San Francisco (domestic)[1]	New York[2]	London[3]			Year	San Francisco (domestic)[1]	New York[2]	London[3]		
			£	s.	d.				£	s.	d.
1914	$49.05	$48.31	[4] 7	15	0	1921	$47.42	$45.46	11	3	5
1915	85.80	87.01	14	10	8	1922	57.78	58.95	11	11	6
1916	125.89	125.49	17	2	10	1923	65.68	66.50	10	4	9
1917	105.32	106.30	22	4	3	1924	68.69	69.76	11	19	8
1918	117.50	123.47		(5)		1925	82.67	83.13	13	17	1
1919	90.29	92.15	20	9	5½	1926	91.60	91.90	15	13	6
1920	79.66	81.12	20	14	9	1927	[6] 117.61	[6] 118.16	[6] 21	7	11

[1] Mining and Scientific Press, San Francisco. } Eng. and Min. Jour.-Press, 1922–1925; Eng. and Min.
[2] Engineering and Mining Journal, New York. } Jour., 1926–27.
[3] Mining Journal (London).
[4] Metal exchange closed about three months after outbreak of war. Average based on 37 weeks only
[5] Quoted as "nominal" only.
[6] Price quoted on 76-pound flask in 1927.

Prices of domestic mercury at San Francisco, 1923–1927, by months[1]

[Per flask of 75 pounds, except as indicated]

Month	1923	1924	1925	1926	1927[2]	Month	1923	1924	1925	1926	1927[2]
January	$71.05	$59.56	$81.16	$90.13	$99.66	July	$66.25	$71.70	$82.71	$90.10	$119.47
February	69.20	59.53	80.90	89.00	100.92	August	65.01	71.47	82.50	89.42	121.50
March	69.53	61.27	80.85	89.01	105.00	September	61.87	71.54	81.28	89.83	120.84
April	70.26	71.33	81.34	89.25	117.87	October	61.00	71.64	81.10	94.27	124.27
May	67.16	72.65	81.60	90.60	124.75	November	61.34	72.43	88.04	98.33	128.79
June	66.80	71.91	82.21	90.71	118.92	December	59.95	70.84	90.39	98.84	129.37

[1] Engineering and Mining Journal.
[2] Price quoted on 76-pound flask after June, 1927.

The rise in price during 1927 must be attributed in the main to the control exercised by the two major producing countries, Spain and Italy. The rapid expansion of the production of Spain coupled with the maintained high production of Italy and the world stocks indicates that world consumption in 1927 was only slightly greater than that in 1926.

IMPORTS AND EXPORTS

In 1927 the general imports of mercury were 24,650 flasks as compared with 28,614 flasks in 1926; thus a considerable decrease is shown from the peak reached in 1926. Although the imports decreased in volume from those of 1926, due to the maintained high price of the year, the total value of imports for 1927 was greater than that of 1926. The origin of the imported mercury in 1927 was Spain, 13,663 flasks; Italy, 9,089 flasks; and the balance of the world, 1,898 flasks. The exports for 1927 were not separately classified. On December 31, 1927, there were 5,736 flasks in bonded warehouses as compared with 2,277 flasks on December 31, 1926.

Mercury imported for consumption in the United States, 1919–1927

Year	Pounds	Metric tons	Flasks	Value
1919	797,613	361.79	10,635	$791,226
1920	1,062,647	482.01	14,169	971,510
1921	795,078	360.64	10,601	457,993
1922	1,269,004	575.61	16,920	757,842
1923	1,355,499	614.84	18,073	816,043
1924	987,719	448.02	13,170	566,820
1925	1,564,112	709.47	20,855	1,200,878
1926	1,948,170	883.68	25,976	1,784,250
1927	1,515,535	687.44	20,207	1,780,134

Mercury imported into the United States, 1924–1927, by countries

[General imports]

Country	1924		1925		1926		1927	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Belgium	3,000	$1,937	11,250	$9,700				
Canada			22,500	18,828	13,310	$11,678		
Chile							300	$490
Cuba	2,475	1,090						
Germany	10,605	5,852	6	7	1,670	1,501		
Hong Kong	5	4					5	6
Italy	583,380	336,025	843,358	640,150	882,589	830,781	681,653	791,060
Mexico	87,096	43,465	74,377	50,607	80,412	67,609	138,268	161,490
Netherlands							3,800	4,458
Portugal					59,220	47,466		
Spain	80,717	45,294	731,569	579,344	1,058,775	966,368	1,024,742	1,231,991
Turkey in Europe					12,600	11,178		
United Kingdom	138,400	87,203	25,500	22,950	37,500	34,877		
	905,678	520,870	1,708,560	1,321,586	2,146,076	1,971,458	1,848,768	2,189,495

Mercury exported from the United States, 1919–1927

Year	Pounds	Metric tons	Flasks	Value
1919	683,004	309.80	9,107	$817,328
1920	116,493	52.84	1,553	129,993
1921	29,501	13.38	393	18,869
1922	21,834	9.90	291	15,910
1923	23,827	10.81	318	25,195
1924	15,581	7.07	208	14,333
1925	15,289	6.93	204	15,930
1926	8,668	3.93	116	10,319
1927	(1)	(1)	(1)	(1)

(1) Not separately classified for 1927.

CONSUMPTION AND SUPPLY

Supply of mercury in the United States, 1908–1927

Year	Production		Imports for consumption		Exports		Apparent supply	
	Flasks	Value	Flasks	Value	Flasks	Value	Flasks	Value
1908	19,752	$872,446	202	$8,216	2,996	$124,960	16,958	$755,702
1909	21,075	957,859	213	8,203	6,802	266,243	14,486	699,819
1910	20,601	958,153	9	381	1,923	91,077	18,687	867,457
1911	21,256	977,989	6,292	251,386	291	13,995	27,257	1,215,380
1912	25,064	1,053,941	1,103	39,920	310	13,360	25,857	1,080,501
1913	20,213	813,171	2,289	75,361	1,140	43,574	21,362	844,958
1914	16,548	811,680	8,198	271,984	1,446	70,753	23,300	1,012,911
1915	21,033	1,804,631	5,625	282,752	3,372	225,509	23,286	1,861,874
1916	29,932	3,768,139	5,659	515,919	8,880	670,475	26,711	3,613,583
1917	36,159	3,808,266	5,207	448,032	10,778	998,470	30,588	3,257,828
1918	32,883	3,863,752	6,719	533,622	3,098	338,620	36,504	4,058,754
1919	21,415	1,933,560	10,635	791,226	9,107	817,328	22,943	1,907,458
1920	13,392	1,066,807	14,169	971,510	1,553	129,993	26,008	1,908,324
1921	6,339	300,595	10,601	457,993	393	18,869	16,547	739,719
1922	6,375	368,348	16,920	757,842	291	15,910	23,004	1,110,280
1923	7,937	521,302	18,073	816,043	318	25,195	25,692	1,312,150
1924	10,085	692,739	13,170	566,820	208	14,333	23,047	1,245,226
1925	9,174	762,616	20,855	1,200,878	204	15,930	29,825	1,947,564
1926	7,642	702,323	25,976	1,784,250	116	10,319	33,502	2,476,254
1927	11,276	1,314,782	20,207	1,780,134	(1)	(1)	[2] 31,300	[2] 3,077,000

(1) Not separately classified for 1927.

[2] Estimated by Bureau of Mines.

Vermilion reds (containing quicksilver), dry or ground in oil or water, imported for consumption in the United States, 1921–1927

Year	Pounds	Value	Duty
1921	4, 756	$4, 138	$620. 70
1922:			
Jan.-Sept. 21	377	276	41. 40
Sept. 22-Dec. 31	12, 991	9, 757	3, 637. 48
1923	78, 449	61, 104	21, 965. 72
1924	96, 410	74, 693	26, 994. 80
1925	173, 334	154, 479	48, 533. 52
1926	176, 020	169, 266	49, 285. 60
1927	108, 076	127, 806	30, 261. 28

PRODUCTION PER MAN EMPLOYED IN MERCURY MINING

Data collected and compiled by the accidents statistics section of the division of mineral statistics, Bureau of Mines, indicate that of the total domestic production of 11,276 flasks of mercury in 1927, 7,811 flasks were produced by 353 men in 116,555 shifts, a production per man day of 0.067 flask.

MINING INDUSTRY BY STATES

ALASKA

In 1927, as in 1926, there was a small production of mercury in Alaska from the Kuskokwim district.

ARIZONA

Occurrences of mercury in Arizona have been known for many years. It seems probable that the first deposits were discovered [7] in the Dome Rock Mountains some time in 1862. The production of Arizona has probably come largely from Copper Basin, Yavapai County. The principal occurrences of mercury in the State are found in the Dome Rock Mountains, in the northern part of Yuma County, about 10 miles east of the Colorado River; in the Copper Basin, Yavapai County, 10 miles southwest of Prescott; in the Phoenix Mountain, Maricopa County, 11 miles north of Phoenix; and at Mazatzal, on the summit of the range between Maricopa and Gila Counties, approximately 70 miles northeast of Phoenix. Mercury has also been reported in the vicinity of the Old Cerro Colorado mine, 45 miles southwest of Tucson, Pima County. A description of the areas listed may be found in Bulletin 122, University of Arizona, "Quicksilver Resources of Arizona," by Carl Lausen and E. D. Gardner, 1927. In 1927 the first shipments of mercury were made from the Tonto mining property situated in the northern part of Gila and Maricopa Counties, north of the Roosevelt Dam. The property has been equipped with a furnace of 50-ton capacity using crude oil as fuel.[8]

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[7] Turner, H. W., Quicksilver: Mineral Industry, 1908, p. 743.

[8] Engineering and Mining Journal: Vol. 124, Dec. 31, 1927, p. 1067.

CALIFORNIA

In 1927 the production of mercury in California was 5,748 flasks as compared with 5,726 flasks in 1926. The 1927 production was 51 per cent of the total production of the United States.

The following are some of the mines productive during 1927: Aetna, Cloverdale, New Idria, Oat Hill, Oceanic, and Sulphur Bank. The Knoxville and Sulphur Bank properties were reequipped with reduction plants. Work was done on the Hastings Quicksilver Mining Co. property in Solano County.

The Cloverdale mine is in Sonoma County and was operated for many years by the Western Mercury Co. The mine was opened in 1872 and through 1918 had produced approximately 8,000 flasks. The underground workings are not extensive, and the larger part of the output has come from open cuts.

The Knoxville mine was known for many years as the Redington. The first production credited to this mine was in 1862, when 442 flasks were produced. Ransome, in Mineral Resources, 1918, Part I, page 170, stated that the works consisted of three shafts and extensive levels, and that the greatest depth attained was 600 feet; that the furnaces were dismantled; that the production from 1893 to the end of 1918 was 120,987 flasks; and that the property was idle in 1918. The property is of interest because the cinnabar occurs associated with pyrite and quartz and there are occurrences of the rare minerals knoxvillite and redingtonite, which are complex hydrous sulphates of chromium, iron, etc. Three veins were developed in the mineralized zone, which is inclosed in serpentine. The gangue mineral is principally black opal. During the early seventies the production of this property, which is estimated to have been 400 flasks per month, was shipped to the Comstock mines, Virginia City, Nev. Extensive tailing dumps are found on the property.

New Idria.—During 1927 two of the mines—the New Idria and the San Carlos—embraced in the holdings of the New Idria Quicksilver Mines (Inc.) were on a productive basis. The property consists of approximately 5,000 acres at an altitude of 3,500 to 4,200 feet in the coast range in San Benito County. Aerial trams connect the two mines with the reduction plant near the town of New Idria. The tramway of the San Carlos mine is 1¾ miles long and that of the New Idria is 3,500 feet long. The ore is delivered to a bin of 1,000-ton capacity at the reduction plant. From the storage bin the ore passes through crushers, where it is reduced to 2-inch size, and is then discharged automatically to the rotary furnaces. The equipment consists of four revolving furnaces 56 feet in length by 5 feet in diameter and driven at 1 to 1¼ revolutions per minute. The roasted ore is discharged from the rotaries, passes into concrete bins, and is delivered to the waste dump by automatic haulage. The fume liberated from the furnaces passes first to a condensing chamber of concrete, thence by glazed sewer-pipe conduits to a concrete condenser, and thence by similar conduits to redwood tank condensers, from which it is delivered to the stacks. Eighty-five per cent of the mercury recovered is caught in and drawn off from the first two condensers. The soot and fine dust are collected by water spray in the conduits and carried to the sump boxes, which are situated at the first condenser. The mercury mixed with the soot and fine dust in the sump boxes is drained from these boxes and is then discharged on shallow concrete tables, which are in the form of vats heated by the exhaust from the power plant. The material so dried is returned to the rotary furnaces. During August, 1927, three of the rotary furnaces were in operation, treating daily about 225 tons of ore said to have a tenor of 6 to 8 pounds of mercury a ton. The major part of this ore was mined at the San Carlos mine. Power is purchased from the Pacific Gas & Electric Co. and is supplied by a transmission line from the Salinas Valley.

The ore shoot of the New Idria mine has been developed to a depth of 1,200 feet; the lowest level is called the twelfth. On the surface this shoot was more than 800 feet long and had a maximum width of 300 feet. It is reported that the exploratory work indicates that the extent of the ore zone on the 1,200 level when fully developed will be equal in area to the surface and other levels previously developed. The deposit has been mined for its high-grade ore. Approximately one-fifth of the original material above the third level has been mined. The third level, which is an adit, cuts through the main ore shoot about midway between its east and west limits. From this level an upraise has been driven in the hanging wall through to the surface. The main ore shoot dips approximately 60° to the south. The major axis of the ore body is east and west. A 4-foot continuous-belt conveyor has been installed on the third level and extends from shoots erected under the raise mentioned to the dump more than 1,000 feet away. The belt is driven by a 40-horsepower motor. Since the installation of this equipment early in the spring of 1927 more than 300,000 tons of waste has been removed from the hanging wall. The estimated total to be removed in order to strip the outcrop is 1,250,000 tons. This stripping operation will, it is said, render available 125,000 tons of ore with a tenor in excess of 0.45 per cent. On the first level of the New Idria a vein known as the New Hope was developed in the old workings. This vein strikes southeast. In the stripping operations of the outcrop the New Hope vein has been exposed on the surface and indicates a virgin territory from which a considerable tonnage of ore may be mined.

At the San Carlos mine, a part of the New Idria property, approximately 1¾ miles southeast of the New Idria mine, the ore occurs in sandstone, and the grade now being mined is approximately 6 to 8 pounds to the ton. The present work is quarrying the old outcrop. The floor of the quarry is 150 feet below the outcrop, but the property has been mined to a depth of 500 feet. The sandstone in which the ore occurs is badly shattered and quite porous; thus an excellent medium for the precipitation of mercury vapor is provided. In the mineralized area in which the New Idria property is situated ore has been developed in most cases where sulphur or sulphur stains occur. Several faults occur in the territory between the New Idria and the San Carlos mines. Since the exhaustion of the New Almaden mine, Santa Clara County, Calif., the New Idria company has become the largest producer of mercury in the United States and the third largest producer in the world. Over 65 miles of work has been done on the two mines developed. In August, 1927, 220 men were employed.

The general geology of the region has been described by G. F. Becker in Geology of the Quicksilver Deposits of the Pacific Slope, United

States Geological Survey Monograph 13, 1888, pages 64, 189, 215, 291–309, and 465–467.

The Oceanic mine is situated in San Luis Obispo County. It was idle from 1921 to 1925, inclusive, but produced in 1926 and 1927. The first production of the mine was made in 1876, when 2,358 flasks were produced. The total accredited production through 1918, as given by Ransome in Mineral Resources, 1918, Part I, page 173, is 24,705 flasks. The greatest depth attained in the mine is 600 feet. The property has been developed by open cuts, tunnels, raises, winzes, and drifts.

The Oat Hill mine is situated in Napa County and consists of 17 patented claims. At one time this property was among the most important in California and through 1918 had produced 131,312 flasks. The first production made from this mine was in 1876. In 1918 an estimate of the ore contained in the old dumps was made, and about 250,000 tons of material carrying 0.15 per cent, or 3 pounds to the ton, was credited to this property.[9] A portion of the dumps of the Oat Hill property has been jigged.

In August, 1927, the reduction plant at the Sulphur Bank property, about 10 miles north of Lower Lake, Lake County, was nearing completion, and it was expected that the property would begin producing before the close of the year. The estimated daily capacity of the plant was 100 tons of crude ore. A Diesel shovel was at work stripping a portion of the old mine preparatory to supplying ore to the mill. In 1918 the Sulphur Bank property was equipped with a steam shovel for handling the ore, and a rotary furnace was in operation. On account of the free sulphur in the ore difficulties were encountered. The sulphur was volatilized in the furnace, but a large part was condensed, and an impure, artificial cinnabar formed.

New Almaden mine.—The New Almaden mine[10] in Santa Clara County is reported to have been discovered in 1824 by Sunol and Chaboya.[11] The owners attempted to extract silver from the cinnabar ore found in what is known as Mine Hill; the property was equipped with a small mill. Before the mine was located, the Indians were claimed to have obtained cinnabar from a natural cave near the top of Mine Hill and used it as pigment. From 1824 to 1835 several attempts were made to extract silver and not until 1845 was the ore identified as cinnabar by one, Andres Castillero. The property was "denounced" by him as a mine of gold, silver, and quicksilver under the name of the Santa Clara mine, and through his efforts William G. Chard, an American, was placed in charge. The first retorting was done in gun barrels, and later a crude retort was built on the plan of a whaler's trying pot.

During the Mexican War the mine was leased for a term of 16 years by one of Castillero's associates to Barron, Forbes & Co. of San

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[9] Bradley, W. W., "Quicksilver Resources of California": California State Min. Bur. Bull. 78, 1918, p. 89.

[10] Rolland, M. G., "Les Gisements de Mercure de Californie": Annales des Mines, Sept.-Oct., 1878. Randol, J. B., "Quicksilver": Mineral Industries in the United States, Eleventh Census, 1890. Becker, G. F., "Geology of the Quicksilver Deposits of the Pacific Slope": U. S. Geol. Survey Mon. 13, 1888, 486 pp. Goodyear, W. A., "Geology of California": Geol. Survey of California, vol. 2, Apr.-May, 1871. Forstner, Wm., "The Quicksilver Resources of California": California State Min. Bur. Bull. 27, 1908. Bradley, W. W., "Quicksilver Resources of California": California State Min. Bur. Bull. 78, 1918. Pamphlets on New Almaden: Vol. 1, Univ. of California Library. United States *v.* Andres Castillero, New Almaden mine, U. S. Dist. Court, Trans. of Record, 7 vol. Coignet, M., Rapport sur les Mines de New Almaden, Paris, 1866.

[11] Aubury, L. E., "The Quicksilver Resources of California": California State Min. Bur. Bull. 27, 1908, p. 174.

Blas and Tepic, Mexico. J. A. Forbes took charge of the property in August, 1846, and the name was changed to the New Almaden.

The first recorded production was made in 1846, when about 2,000 pounds of mercury was produced. The men engaged in reduction of the ore were salivated, and in October, 1846, the mine was abandoned. During the period 1846 to 1850 the property changed hands several times by sale and relocation, and there is no record of any production. In 1850 the property consisted of 8,500 acres and produced 23,875 flasks in the fiscal year ended June 30, 1851. The peak of production was reached in 1865 with 47,194 flasks, and in 1927 the mine was reported idle. It had been continuously active from 1850 until it was closed down in 1926, with the exception of a period from November, 1858, to January, 1861, when the property was under litigation. This litigation was caused by the relocation of the mine following alleged abandonment. An injunction was sought by the United States against the operators. The property became internationally famous, as Emperor William of Germany was called upon to act as arbitrator between the English and Mexican claimants. The award of the title of the property was made to the English company, and $1,500,000 was paid to the Mexican claimants, thus quieting title. Because of the discovery of gold in California and the utilization of mercury in its recovery many adverse comments were made by the gold miners on the Government action, and the injunction was most unpopular. The comment of the day was that closing a mine by Federal injunction is the exercise of a power dangerous to the mining interest of the State.

The mining laws of the United States had their inception in the code promulgated by early California miners. The laws so framed attempted to protect possessory title and to prevent the location of properties that were not to be actively worked. The abandonment of a mining location for a short time constituted in many instances the forfeiture of the title and gave the right of relocation to others, often resulting in an appeal to the courts. The New Almaden property was in litigation for many years; the story of the lawsuits is recorded in a multitude of folios scattered through the archives of Mexico and the United States, as well as in the daily press. The titles of some of the publications indicate the trend of public opinion at the time. "How to Get a Mine without Finding, Opening, or Working One," written by one calling himself "a quartz miner," is indicative of the suspicion that certain officials were less concerned in obtaining a mine for the United States than for their personal friends. The development of this mine played a prominent part in the early history of California. At one time it was the center of California's politics and was actually instrumental in the election of a governor.

From 1850 to 1858 the average tenor of the ore treated varied between 19 and 37 per cent of mercury. The great value of this ore can possibly be better appreciated by a comparison with the average tenor of ores treated in the United States in 1926; namely, 0.54 per cent. The table following shows the production of mercury in the New Almaden from July, 1850, to April 30, 1896. It has been quoted in order to call attention to the tonnages of ore treated and the tenor of the ore and shows year by year the decrease in tenor and increase in tonnages of crude material, thus indicating improvement in metallurgy and in methods of mining.

Quicksilver production at New Almaden, Santa Clara County, Calif.,[1] July, 1850, to April 30, 1896

DATE	CLASS AND QUANTITY OF ORE			Total (pounds)	Flasks from furnaces	Flasks from washings	Total flasks	Average amount per month (flasks)	Percentage yield of quicksilver	Number of months
	Grueso [2] (pounds)	Granza [2] (pounds)	Tierras [3] (pounds)							
July, 1850, to June, 1851				4, 970, 717	23, 875		23, 875	1, 989½	36. 74	12
July, 1851, to June, 1852				4, 643, 290	19, 921		19, 921	1, 660	32. 82	12
July, 1852, to June, 1853				4, 839, 520	18, 035		18, 035	1, 503	28. 50	12
July, 1853, to June, 1854				7, 448, 000	26, 325		26, 325	2, 193¾	27. 03	12
July, 1854, to June, 1855				9, 109, 300	31, 860		31, 860	2, 655	26. 75	12
July, 1855, to June, 1856				10, 355, 200	28, 083		28, 083	2, 340¼	20. 74	12
July, 1856, to June, 1857				10, 299, 900	26, 002		26, 002	2, 167	19. 31	12
July, 1857, to June, 1858				10, 997, 170	29, 347		29, 347	2, 445½	20. 41	12
July, 1858, to October, 1858				3, 873, 085	10, 588		10, 588	2, 647	20. 91	4
November, 1858, to January, 1861	Closed by Injunction.									
February, 1861, to January, 1862				13, 323, 200	32, 402	2, 363	34, 765	2, 897	19. 96	12
February, 1862, to January, 1863				15, 281, 400	39, 262	1, 129	40, 391	3, 366	20. 22	12
February, 1863, to August, 1863				7, 172, 660	17, 316	2, 248	19, 564	2, 795	20. 86	7
September, 1863, to October, 1863				2, 346, 000	4, 820	700	5, 520	2, 760	18. 00	2
November, 1863, to December, 1863	54, 800	1, 586, 500	718, 000	2, 359, 300	4, 040	407	4, 447	2, 223½	18. 65	2
January, 1864, to December, 1864	1, 259, 400	18, 730, 300	3, 287, 900	23, 277, 600	42, 176	313	42, 489	3, 540¾	13. 96	12
January, 1865, to December, 1865	2, 288, 900	25, 749, 000	3, 910, 500	31, 948, 400	47, 078	116	47, 194	3, 933	11. 30	12
January, 1866, to December, 1866	1, 506, 000	19, 939, 100	5, 440, 200	26, 885, 300	34, 726	424	35, 150	2, 929	10. 00	12
January, 1867, to December, 1867	731, 500	15, 689, 288	9, 603, 145	26, 023, 933	23, 990	471	24, 461	2, 038½	7. 19	12
January, 1868, to December, 1868	2, 274, 208	14, 566, 600	12, 564, 722	29, 405, 530	25, 577	51	25, 628	2, 135⅔	6. 66	12
January, 1869, to December, 1869	150, 000	11, 942, 175	13, 366, 000	25, 458, 175	16, 898		16, 898	1, 408	5. 07	12
January, 1870, to December, 1870	30, 000	12, 531, 900	8, 535, 800	21, 097, 700	14, 423		14, 423	1, 202	5. 23	12
January, 1871, to December, 1871		13, 661, 700	8, 373, 000	22, 034, 700	18, 563	5	18, 568	1, 547⅓	6. 44	12
January, 1872, to December, 1872	142, 000	12, 777, 000	8, 497, 600	21, 416, 600	18, 391	183	18, 574	1, 548	6. 63	12
January, 1873, to December, 1873		8, 492, 375	8, 838, 000	17, 330, 375	11, 042		11, 042	920	4. 87	12
January, 1874, to December, 1874		11, 294, 000	12, 160, 000	23, 454, 000	8, 867	217	9, 084	757	2. 96	12
January, 1875, to December, 1875		12, 236, 000	18, 870, 200	31, 106, 200	13, 541	107	13, 648	1, 137⅓	3. 35	12
January, 1876, to December, 1876		14, 784, 550	18, 532, 400	33, 316, 950	20, 549		20, 549	1, 712½	4. 71	12
January, 1877, to December, 1877		13, 987, 700	23, 243, 600	37, 231, 300	23, 996		23, 996	1, 999¾	4. 93	12
January, 1878, to December, 1878		14, 612, 154	22, 330, 071	36, 942, 225	15, 852		15, 852	1, 321	3. 28	12
January, 1879, to December, 1879		16, 032, 085	39, 033, 050	55, 065, 135	20, 514		20, 514	1, 709½	2. 85	12
January, 1880, to December, 1880		15, 267, 650	46, 087, 200	61, 354, 850	23, 465		23, 465	1, 955½	2. 92	12
January, 1881, to December, 1881		14, 430, 510	49, 710, 625	64, 141, 135	26, 060		26, 060	2, 171¾	3. 10	12
January, 1882, to December, 1882		19, 734, 900	52, 412, 300	72, 147, 200	28, 070		28, 070	2, 339	2. 97	12
January, 1883, to December, 1883		21, 227, 500	55, 935, 000	77, 162, 500	29, 000		29, 000	2, 416½	2. 87	12
January, 1884, to December, 1884		16, 410, 000	62, 841, 000	79, 251, 000	20, 000		20, 000	1, 666½	1. 93	12
January, 1885, to December, 1885		17, 644, 300	61, 425, 000	79, 069, 300	21, 400		21, 400	1, 783	2. 07	12
January, 1886, to December, 1886		14, 140, 690	67, 258, 000	81, 398, 690	18, 000		18, 000	1, 500	1. 69	12
January, 1887, to December, 1887		12, 648, 300	51, 503, 000	64, 151, 300	20, 000		20, 000	1, 666½	2. 38	12
January, 1888, to December, 1888		11, 140, 600	46, 185, 000	57, 325, 600	18, 000		18, 000	1, 500	2. 40	12
January, 1889, to December, 1889		9, 398, 200	48, 377, 000	57, 775, 200	13, 100		13, 100	1, 091⅔	1. 73	12

January, 1890, to December, 1890		8, 079, 800	37, 220, 000	45, 299, 800	12, 000		12, 000	1, 000	2. 02	12
January, 1891, to December, 1891		5, 404, 700	45, 764, 000	51, 168, 700	8, 200		8, 200	683⅓	1. 22	12
January, 1892, to December, 1892		13, 694, 000	45, 498, 700	59, 192, 700	5, 610		5, 610	467½	. 72	12
January, 1893, to April, 1894		6, 797, 260	51, 411, 940	58, 209, 200	9, 449		9, 449	590½	1. 24	16
May, 1894, to April, 1895		10, 136, 900	41, 979, 000	52, 115, 900	7, 000		7, 000	583⅓	1. 03	12
May, 1895, to April, 1896		8, 461, 300	56, 812, 000	65, 273, 300	6, 300		6, 300	525	. 74	12
	8, 436, 808	443, 229, 037	1, 037, 723, 953	1, 594, 049, 240	933, 713	8, 734	942, 447	1, 802	4. 57	523

Product of Enriquita[4] from 1860 to 1863 .... 10,571 flasks

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[1] Aubury, L. E., The Quicksilver Resources of California: Calif. State Min. Bur. Bull. 27, 1908, pp. 176–178.
[2] Grueso and Granza—Spanish words, meaning coarse ore.
[3] Tierras—Spanish word, meaning fine ore.
[4] A body of ore separate from the main workings.

Total product of all the mines on the company's property to above date, 953,018 flasks of 76½ pounds each, or 72,905,877 pounds, or 36,452.94 tons of quicksilver. Since 1896 the figures of annual product have been kept private by the company.

Attention is called to the period 1865 to 1875 in which production was on the wane. During the years prior to 1875 reduction methods were crude. The fine ores had to be molded into mud bricks or adobes, in other words crudely briquetted, before they could be treated; and as the higher grade lump ores were exhausted more and more fines had to be handled. In 1875 the Scott furnace [12] was invented at New Almaden. This furnace solved the problem of fine-ore treatment, and the consequent improvement in the metallurgy of mercury is indicated in the increased production during the next 10 to 15 years. During these same years the New Almaden was using the Exeli continuous-shaft furnace developed in Idria, Austria, while the Scott furnace idea was carried to Austria from America, and its continental equivalent was evolved in the Cermak-Spirek furnace. It thus becomes evident that the metallurgical improvements evolved at the New Almaden were world-wide in effect and had a material influence on the beneficiation of mercury ore. One of the most complete studies of the condensation of mercury was made in the years just before 1885 by Samuel B. Christy, of the University of California. A description of his findings appears in Transactions of the American Institute of Mining Engineers, volume 14, 1885–86, pages 206–265.

The New Almaden mine was one of the first large developments in this country. The value of its gross production has been estimated at $65,000,000 to $75,000,000. There are more than 84 miles of underground workings on the property, and it is reported that the mine was worked to a depth of 2,450 feet below the crest of Mine Hill. This mine was one of the first to adopt mine mapping, and the old mine maps furnish an excellent example of mine surveying and illustrate the high degree of efficiency attained in this branch of engineering. In their day they were unexcelled.

The New Almaden mine adopted machine drills long before they were installed in other mining districts; another contribution to mining was the method of timbering utilized in handling relatively horizontal stopes. The New Almaden was also one of the earliest properties to adopt electric firing of explosives.

With the advent of lode mining in California mining camps were established which were notorious for poor housing and sanitary conditions. The mining camp of New Almaden was no exception. In 1870 there were three camps on the property, known as the English camp, Spanish Town, and the Hacienda, with a combined population of 1,400 to 1,600, of whom 400 to 700 were men engaged in mining. Seventy-five per cent of the population was Spanish-American or Mexican, 20 per cent was Cornish, and the remaining 5 per cent was made up of Americans, Germans, and Swedes. In 1870 J. E. Randolph brought order to this wild, lawless community, installed hospitals, a resident physician, and nurses, and inaugurated what was known as the Miners' Fund of New Almaden. This plan is described in detail by Christy in the Transactions of the American Institute of Mining Engineers, volume 13, 1884–85. This record is the first in this country of the application of such ideas in a mining camp. The health conditions at New Almaden embodied in this plan were discussed at length in the records of a lawsuit in 1886. In 1923 a celebration was held at the mine commemorating the hundredth anniversary.

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[12] Duschak, L. H., and Schuette, C. N., "The Metallurgy of Quicksilver": Bull. 222, Bureau of Mines, 1925, pp. 48–56.

Lindgren[13] has epitomized the geology of the deposit as follows:

> The great mine of New Almaden, in Santa Clara County, south of San Francisco, is opened in shattered greenstone, serpentine, radiolarian chert, and sandstone of the Franciscan series. Considered in detail the ore-bodies are stockworks, but they are arranged along definite fissures and have on the whole a vein-like character. There are two main fissures of varying dip along and from which the ore-bodies extend. The hanging wall is usually an impermeable, slickensided clay. There are no hot springs in the vicinity, and the only eruptive rock is a rhyolite dike parallel to the fissures.

The old Spanish Town and English camp have long been abandoned, and in 1927 a real-estate firm was subdividing the Hacienda territory for residential purposes and dismantling the old Hacienda office. The foundations of the old Scott furnace were excavated in 1918 to a depth of 30-odd feet and more than 500 flasks of mercury were recovered from material having a tenor of 0.17 per cent.[14] The various shafts, at one time 17 in number, are now going to rack and ruin. The so-called new plant at the El Senador mine, erected in 1917, was in charge of a watchman in 1927.

There was a watchman also at the Guadalupe mine; this mine was discovered in the early fifties, and to the end of 1925 had produced approximately 88,762 flasks of mercury. The property consists of 25 acres and is 10 miles south of San Jose on the West Ridge, adjoining the New Almaden holdings. It was first worked by a vertical shaft 625 feet deep, near the bottom of Capitancillos Creek, and later a 700-foot 3-compartment incline shaft was sunk to this same level. One of the difficulties encountered was the flooding of the mine workings by seepage water from the creek, and in 1918 an attempt was made to dewater the old mine by means of a concrete flume. The installation of the flume was not a success, and when viewed by the author in 1927 the workings of the property were flooded.

As one of the requirements of mining large disseminated bodies of ore is unified ownership, the present trend of affairs—namely, the subdivision of the property—indicates a commercial problem for the future miner of the New Almaden area which may prove insurmountable. In 1927, however, the atmosphere of the place evidenced abandonment.

IDAHO

In 1927 there was no production of mercury from Idaho. Development work, however, was being carried on in a mineralized area that contains cinnabar in the Yellow Pine district of Valley County, as mentioned in the 1926 chapter of this series. The district has been described by Schrader and Ross.[15] The area in which cinnabar occurs is largely controlled by the United Mercury Mines Co. and the Fern Quicksilver Co. The holdings of the United Mercury Mines Co. were under lease and bond to F. W. Bradley of San Francisco, Calif.; the property was being thoroughly sampled, and some development work was being done. The Fern property was also under development.

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[13] Lindgren, Waldemar, Mineral Deposits: 1913, p. 468.

[14] Ransome, F. L., "Quicksilver": Mineral Resources, 1918, pt. 1, p. 162.

[15] Schrader, F. C., and Ross, C. P., "Antimony and Quicksilver Deposits, in the Yellow Pine District": U. S. Geol. Survey Bull. 780–d, 1926, pp. 137–164.

NEVADA

During 1927 a considerable amount of work was done in what is claimed to be rather a large mercury-bearing district in the East Range about 21 miles east of Lovelock, Pershing County. Two properties, one known as the Pershing Quicksilver Co. and the other as the Nevada Quicksilver Mines (Inc.), were being developed and equipped during the year. The Pershing Quicksilver Co. is reported to have a tonnage of ore running from one-half to seven-eighths of 1 per cent; the ore body is said to be over 40 feet wide in places, and the mine is equipped with a Gould furnace and was a producer in the latter part of 1927. The Nevada Quicksilver Mines (Inc.) property is in the East Range 1 mile from the property of the Pershing Quicksilver Co. An incline shaft has been sunk 200 feet in depth, and drifts have been run from the 100-foot level showing the ore body to be 8 to 9 feet wide; it contains, according to the owner's statement, 3 per cent of mercury. It is expected that the property will be a producer during 1928.

In 1927 mercury was produced also in Esmeralda, Lander, Mineral, and Nye Counties.

The Dayton Syndicate and Geo. Fuerman recovered 226 flasks of mercury in 1927 from gold and silver pan-amalgamation tailings. These figures are not included in the production for 1927, as they represent mercury that has entered into the statistics of production for some earlier year.

OREGON

During 1927 the Elkhead mercury mine, 7 miles east of Yoncalla, was being reequipped. The Quicksilver Syndicate, Blackbutte, near Gold Hill, was reequipped with a Gould furnace of 100-ton capacity and produced in 1927. The Pacific Quicksilver Co. produced from Crook County. The most important mercury property in Oregon, from the standpoint of production, is the Opalite mine of the Mercury Mining Syndicate in the southwestern part of Malheur County, approximately 9 miles northeast of Disaster Peak. The property consists of eight mining claims. The mine is accessible by wagon road from Winnemucca, Nev., via McDermitt, a distance of 97 miles. The wagon road from McDermitt to the Opalite mine is impassable at certain seasons of the year. The freight rate from Winnemucca to the property is $30 per short ton, or 1½ cents per pound.

The mineralized area is confined to an area covering about 1½ acres and consists of a tuff altered to chalcedony in which cinnabar occurs. Deposition of the mercury is attributed to the action of hot mineral solution. The mercury minerals found are cinnabar, which predominates, and terlinguaite. Intensive development of the property has shown that ore deposition does not extend to a greater depth than 50 feet and is approximately 150 feet wide by 350 feet long. The property is worked by the glory-hole system. A drift has been driven 100 feet below the outcrop, and from this drift several upraises have been made through to the surface. In August, 1927, three glory holes, connected by shoots and raises to the lower drift, were being operated. More than 12,000 tons of ore had been mined, indicating an approximate tenor of 0.44 per cent, or 8.8 pounds to the ton. Near the northwest boundary of the property is an east-west fault. What is known as No. 1 tunnel has been driven several hundred feet into the hill in the vicinity of this fault but only a small streak of high-grade ore has been encountered. This streak is not wide enough to justify profitable mining. It is surmised that the fault was subsequent to the mineralization of the area.

The ore mined from the glory hole is trammed from the lower level to the ore bins, where it is passed through two Blake crushers in two stages and crushed to 1½ inches. It is then delivered to the rotary furnace. This furnace is 72 feet in length and 4 feet in inside diameter. Near the feed end is a 12-foot bulge 6 feet in diameter. The ore is delivered to the furnace by a pulsating feeder and is introduced about 10 feet from the intake. Oil is used as fuel and is burned in a burner designed by the R. W. Ryder Engineering Co., of San Francisco, Calif. The condensing system is a combination of horizontal and vertical section 12-inch glazed sewer pipe. The vapor from the furnace passes through a Cottrell precipitator, where 96 per cent of dust is precipitated. This dust contains 1 to 2 pounds of mercury to the ton and is wasted. From the precipitator the vapor passes through six ducts each 66 feet in length to 12 by ¼ inch iron pipes, through 192 feet of 12 by 12 inch sewer tile pipe, to the fan, and to a wooden cyclone and stack. In August, 1927, the plant was treating about 60 tons of ore. About 80 tons of material was being mined per day; one-fifth of the rock mined was discarded by hand sorting. Thirty men were employed. The output averaged about 7 flasks a day.

A mercury (cinnabar) deposit in rhyolite about 2 miles east of the Opalite mine was worked in the past but was not productive in 1927.

TEXAS

The production of mercury in Texas is now confined to the Terlingua district of Brewster County. The first production from this district was made in 1899 and consisted of 1,000 flasks. The mercury-bearing mineralized area in Brewster County lies about 98 miles south of Alpine, the county seat. The extent of the area has not been accurately determined. The apparent width is approximately 3 miles; the known length is about 7 miles, and may be as great as 40 miles. Topographic maps, but no geological maps, of this section are available. With the exception of a cursory geological reconnaissance of the district, the results of which were published in Bulletin 93, University of Texas, and of a description of the geology and existing mines by F. L. Ransome in Mineral Resources, 1917, Part I, pages 422–424, little accurate information as to the possibilities of the district is available to the public. The known ore bodies are along the strike of a fault zone known as the Chisos fault. The fault may be followed for several miles and has a nearly vertical dip and general east-west strike which changes at the western extremity to southwest. From east to west the following properties have been located on the Chisos fault: Dallas mine (Texas Almaden Mining Co.), Study Butte (Big Ben mine), Colquitt-Tignor (sec. 248), Cigar Mountain, Chisos mine, Rainbow mine, and Southeast-Southeast section

38. The geological formations [16] of the district have been given as follows:

Upper Cretaceous:
- Chisos beds.
- Tornillo beds.
- Rattlesnake beds.
- Terlingua beds.
- Boquillas flags.

Lower Cretaceous:
- Buda limestone.
- Del Rio clays.
- Edwards limestone.

Ransome, in Mineral Resources, 1917, Part I, page 422, gives the thickness of the formations occurring at the Chisos mine as the Austin chalk (Terlingua beds), not over 50 feet thick; the Eagle Ford (Boquillas flags), about 500 feet thick; the Buda limestone, 100 feet thick; and the Del Rio clay, 75 to 100 feet thick.

The surface formation at the Study Butte is the Terlingua shale (Austin chalk) underlain by Boquillas flags (Eagle Ford formation); both formations are cut by a gray porphyry. In both mercury has been mined on the Study Butte and the Big Ben properties. These formations are 600 to 700 feet stratigraphically above the formations found on the Chisos mine property, which is approximately 3½ miles west of the first-named properties. Ore has been mined above the 580-foot level of the Chisos mine in the Buda limestone. The inference to be drawn is that ore may be encountered in the Study Butte area at the corresponding horizon. Furthermore, Ransome states that on the 580-foot level of the Chisos mine large quantities of ore have been stoped from the Eagle Ford formation (Boquillas flags). This formation overlies the Buda limestone, and the ore shoot continues down through the latter into the Edwards limestone.

Near the western limits of the mineralized zone, in what is known as California Hill, some 28,000 flasks of mercury had been produced through 1918 from shallow pits and trenches in the Edwards limestone. On this property was located the Mariposa mine, formerly known as the Marfa and Mariposa. The Mariposa property is situated near what is known as the Margaret D. fault. No work has been done on this mine for several years. In a horizontal distance of about 7 miles between the Study Butte property on the east and the Mariposa on the west there is a difference of more than 1,400 feet in geological horizon. Mercury ore has been mined from the formations in this interval.

The largest mine in the district is the Chisos mine of the Chisos Mining Co.; the company discloses little information concerning the mine. At present the mine is being operated through three shafts. The main shaft is said to be 750 feet deep. The Chisos mine has been worked practically continuously for 38 years. In the summer of 1927 a 24-ton Scott furnace with a brick condenser was being operated. In 1917 a rotary furnace was installed but after a short period of operation was closed down. The mine employs approximately 100 men. The wages of common labor vary from $1 to $1.50 a day. Power is supplied by engines of the Diesel type, and fuel is hauled from Marathon, approximately 100 miles away. Under the Scott furnace wood is used as fuel; it consists largely of mesquite brush and costs $10 per cord. Water is scarce in the district and is pumped about 7 miles to within 1½ miles of the town of Chisos, then delivered by tank wagon to the inhabitants.

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[16] Udden, J. A., "A Sketch of the Geology of the Chisos Country, Brewster County, Tex.": Univ. of Texas Bull. 93, 1907, p. 17

The Dallas and Big Ben properties at Study Butte after producing a small amount of mercury were shut down a number of years ago, as surface water was encountered at 120 feet. The water was probably due to seepage from Terlingua Creek and does not represent the permanent water level, which, it is assumed, is at a depth of 750 feet.

Occurrences of cinnabar ore are found on section 248, a part of the old Colquitt-Tignor property.

On section 39 what is known as the 39 Mining Co. made a small production. The property is equipped with a 4-retort furnace. The work being done upon the property consists largely of prospecting.

The Margaret D. fault extends through section 39, passing into what is known as the Waldron property. This property consists of eight full mining claims and was a part of the old Colquitt-Tignor mines, situated in the NW. ¼ NW. ¼ of section 38, on the Margaret D. fault. This property is separated from the 39 property by a ridge composed largely of Edwards limestone. The ridge rises to an altitude of approximately 3,300 feet above sea level and is cut almost at right angles by the Margaret D. fault. On the northern flank of this ridge at an altitude of about 3,270 feet the outcrop of the Waldron mine is found. This mine is equipped with a crushing plant and a 12-ton Scott furnace with brick condensers. The surface plant has been arranged in such a manner that a high degree of efficiency is attained with a minimum requirement of labor. Drifting to the extent of about 900 feet has been done by the present owners. The main drift, about 360 feet long, has been driven along the Margaret D. fissure and is 75 feet below the collar of a shaft on the outcrop near the brow of the ridge and connected with this drift. From the 75-foot level a winze approximately 100 feet deep has been sunk. In all about 1,600 feet of development work has been done. In driving the 75-foot level a vug 200 feet long was encountered that varied from 2 to 8 feet in height and from 4 to 30 feet in width. On the sides of this cave was found a veneering of ore running better than 0.5 per cent. The ore occurs in the Edwards limestone. The fissure is filled with breccia and lime spar, part of which has been replaced by cinnabar. In August, 1927, 14 men were employed; common labor was receiving $1 and miners $1.25 per day. Wood was $10 per cord and water $5 per tank of 250 gallons at that time.

In addition to the properties mentioned seven claims have been located on the Chisos fault adjoining the Rainbow mine on the west.

The Rainbow mine consists of five claims, containing approximately 103 acres, at an elevation of 2,800 feet above sea level. The Chisos fault fissure outcrops for 1,500 feet on the property. Ore that occurs on this property is found as stockwork or veinlets.

Although in 1927 there were only three properties producing in Texas—the 39, the Chisos, and the Waldron—the possibilities of the mineralized area would appear to include opportunity for production at other points which might be determined by a study of structural geology. With the fault system worked out there seems little doubt that new discoveries will be made and that development work in the area could be carried out with a better chance of success.

WASHINGTON

In 1927 the production of mercury in Washington was 566 flasks as compared with 489 flasks in 1926. The first official mention of occurrences of cinnabar in Washington was made by Becker[17] of the United States Geological Survey in 1888. Reference was made to specimens presented to the Survey from Puget Sound, Washington Territory. In 1906 George Otis Smith, in the Snoqualmie Folio No. 139, Geologic Atlas, United States Geological Survey, 1906, page 14, mentioned occurrences of cinnabar in Kittitas County. According to this statement cinnabar was found in the altered rocks along a joint plane in the Peshastin formation. The ore occurred in such thin bands that the deposits were thought to be of no commercial value.

The occurrences of mercury in Chelan and Kittitas Counties were summarized in Mineral Resources, 1911, Part I, page 916.

In Mineral Resources, 1915, Part I, page 274, mention is made of the development of a deposit of cinnabar 2 miles from Morton. The property was equipped with a 12-pipe Johnson-McKay retort. No production was made during that year. The first recorded output was in 1926, when 489 flasks were produced. This mine was the only producer in the State in 1926 and 1927.

WORLD'S PRODUCTION

World's production of mercury, 1923–1927, by countries

[Compiled by L. M. Jones, of the Bureau of Mines]

[1 metric ton=29.395 flasks]

Country [1]	1923		1924		1925		1926		1927	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	--------	--------	79	2.7	55	1.9	76	2.6	29	1.0
Austria	--------	--------	132	4.5	179	6.1	208	7.1	162	5.5
Canada	--------	--------	--------	--------	--------	--------	5	.2	--------	--------
China [2]	47	1.6	85	2.9	97	3.3	(3)	(3)	(3)	(3)
Czechoslovakia	1,514	51.5	2,287	77.8	2,158	73.4	2,419	82.3	(3)	(3)
Italy	48,666	1,655.6	48,237	1,641.0	53,898	1,833.6	54,998	1,871.0	58,672	1,996.0
Japan	(4)	(2)	--------	--------	--------	--------	--------	--------	(3)	(3)
Mexico	1,316	44.8	1,078	36.7	1,138	38.7	1,335	45.4	2,396	81.5
New Zealand	--------	--------	--------	--------	--------	--------	--------	--------	21	.7
Rumania	(5)	(5)	8	.3	97	3.3	59	2.0	105	3.6
Russia [6]	1,155	39.3	1,919	65.3	291	9.9	3,727	126.8	(3)	(3)
Spain	33,646	1,144.6	26,417	898.7	37,546	1,277.3	46,861	1,594.2	73,281	2,493.0
United States	7,937	270.0	10,085	343.1	9,174	312.1	7,642	260.0	11,276	383.6
	94,281	3,207.4	90,327	3,073.0	104,633	3,559.6	117,330	3,991.6	(3)	(3)

[1] In addition to the countries shown in the table Turkey is a producer of mercury. Information furnished on May 21, 1923, by the United States High Commissioner of Turkey places this country's average annual production at approximately 67 tons (1,969 flasks). These figures are not included in the above totals.

[2] Exports. Statistics of production are not available; official estimates of the output in 1925 range from 128 to 470 metric tons.

[3] Data not available.

[4] 4 kilograms reported.

[5] Production of 200 tons of ore reported; metallic content not stated.

[6] Year ended Sept. 30.

In 1927, 11 countries contributed to the world's production of mercury, and 73 per cent of this production may be attributed to three mines—the Almadén of Spain, the Abbadia-San Salvador mine of Italy, and the New Idria mine of the United States.

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[17] Becker, G. F., "Geology of the Quicksilver Deposits of the Pacific Slope": U. S. Geol. Survey Mon. 13,1888, pp. 201-202.

FOREIGN SOURCES

SPAIN

The production of mercury in Spain is confined to two sources—the Government-owned mine in the Province of Ciudad Real, known as the Almadén, and a property situated in the Province of Granada. The Almadén accounts for approximately 98 per cent of the total Spanish production. The holdings of the company occupy an area of approximately 83,252 hectares, only a small portion of which is being worked. The present workings of the Almadén mine are confined to several thousand meters along the strike of the vein. The known reserves of the property, the high grade of the ore, and the low cost of production are contributing factors which give this mine supremacy over all other mercury mines of the world. Although nominally the output of the mine is annually sold for the ensuing year to the highest bidder, the product of the mine is actually marketed by the Sociedad Española del Mercurio. (See Mineral Resources, 1926, Part I, p. 138.)

In September, 1927, the award was made for the 1927 and 1928 production of mercury from the Almadén mine. Bids were submitted by the Sociedad Española del Mercuric, Italiano Monte Amiata, Lazard Bros., Santa Barbara de Bilbao, and Antonio Lopez Roberts. The bids varied between £15 and £17 sterling per flask of 75 pounds. The highest bid, £17 sterling, was made by Lazard Bros. In principle, they received the award. However, the Sociedad Española del Mercurio, directors of the Almadén and Arrayanes mines, exercised the contract right enjoyed by them; namely, that it lies within their discretion to take over themselves the sale of the annual output at a price equal to that of the highest bidder. Thus, the award for the year was taken over by the Sociedad Española del Mercurio at £17 sterling per flask. To the consumer in the United States this price means $82.64 plus the present duty of $18.75, or a total of $101.39, to which must be added commission for sale and purchase and transportation costs.

The following table gives the output and power employed in production at the Almadén mine during the 10-year period, 1917 to 1926:[18]

Exploitation of Almadén mercury mine, 1917–1926

Year	Laborers below ground	Laborers above ground	Steam horse-power	Electric horse-power	Internal combustion horse-power	Ore produced (metric tons)
1917	478	754	235			10,063
1918	452	784	235			8,910
1919	317	656	350			18,579
1920	393	666	350			14,072
1921	420	663	350			12,076
1922	430	665	350			13,513
1923	381	638	205	60	600	14,765
1924	388	635	100	60	600	14,522
1925	435	645	100	60	600	21,519
1926	442	435	160	100	600	29,131
Average	413.6	654.1				15,715

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[18] Hester, Evett D., assistant commercial attaché, Madrid, Spain, Dec. 30, 1927.

From the preceding table it will be seen that the number of laborers employed in 1926 was approximately but 80 per cent of the average for the 10 years, whereas the production of ore in 1926 was nearly double the 10-year average, and that by use of internal combustion engines and electric power the output of 1926 was nearly three times that of 1917.

The metallurgical side of the industry is indicated by the following table [19]:

Metallurgical results obtained at the Almadén mine, 1917–1926

Year	Number of laborers	Number of retorts	Steam hp.	Electric hp.	Mineral treated (metric tons)	Metal obtained (kilograms)	Average purity (per cent)	Estimated value (pesetas)
1917	395	28	20	--------	11, 944	827, 115	6. 925	9, 228, 130
1918	362	26	20	--------	8, 255	544, 654	6. 622	6, 076, 524
1919	318	24	20	--------	19, 927	1, 207, 631	6. 06	19, 261, 714
1920	372	24	20	--------	20, 687	484, 840	6. 06	11, 756, 434
1921	365	13	20	--------	10, 337	619, 004	(1)	5, 471, 995
1922	412	13	20	--------	25, 006	1, 314, 160	(1)	11, 817, 535
1923	363	24	--------	5	22, 133	1, 136, 071	8. 00	10, 735, 871
1924	395	24	--------	5	18, 340	893, 663	7. 00	8, 445, 105
1925	440	26	--------	5	20, 884	1, 270, 541	7. 66	14, 359, 410
1926	366	23	--------	5	30, 354	1, 588, 821	5. 23	17, 397, 590
Average	379	--------	--------	--------	18, 787	988, 650	--------	11, 455, 031

[1] Data not available.

Comparing the results for 1926 with the average for the past 10 years it will be seen that whereas the number of laborers in 1926 was only slightly under the average the production for 1926 was 60 per cent above the average.

Mercury produced in Spain, 1925–26

Province	Number of mines	Workmen		Ore mined		Metal produced		
		At mines	At plants	Metric tons	Tenor (per cent)	Flasks	Value [1]	Flasks per man
1925								
Ciudad Real	1	1, 080	440	21, 519	7. 66	37, 346	$2, 059, 714	24. 57
Granada	3	30	15	1, 074	. 95	200	10, 148	4. 44
	4	1, 110	455	22, 593	----------	37, 546	2, 069, 862	23. 99
1926								
Ciudad Real	1	877	366	29, 131	5. 23	46, 703	2, 591, 545	37. 57
Granada	3	24	8	877	. 95	158	8, 586	4. 94
	4	901	374	30, 008	----------	46, 861	2, 600, 131	36. 75

[1] Exchange rate of peseta: 1925, 14.344 cents; 1926, 14.896 cents.

ITALY

In the chapter of this series in Mineral Resources, 1925, Part I, page 48, statement was made that the Italian mines were owned by the Government. This is in error. The Abbadia-San Salvador mine, as well as others in the Monte Amiata district, are privately owned and operated, whereas those of the Idria district are owned and operated by the Italian Government.

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[19] See footnote 18.

In 1927, as in the past, the largest part of Italy's production of mercury came from the Monte Amiata district, near Siena in Tuscany. The largest producing mine in this district is the Abbadia-San Salvador mine. Practically all of the shares of this company are in the hands of the Banca Commerciale Italiana of Milan.

Approximately 30 per cent of Italy's output comes from the Royal Idria mine, situated in the Trieste district. The mine is owned and controlled entirely by the Italian Government.

Mercury produced in Italy, 1925–26

Province	Number of mines	Workmen		Tenor of ore (per cent)	Metal produced		
		At mines	At plants		Flasks	Value [1]	Flasks per man
1925							
Friuli (Trieste)	1	812	140	(2)	13,186	$767,305	13.85
Grosseto	3	432	133	0.54	5,850	316,649	10.35
Siena	3	977	509	1.26	34,862	2,203,812	23.46
	7	2,221	782	----------	53,898	3,287,766	17.95
1926							
Friuli (Trieste)	1	830	136	.77	14,286	945,027	14.79
Grosseto	4	465	206	.51	6,320	418,068	9.42
Roma	1	26	----------	.60	(3)	(3)	(3)
Siena	3	1,016	577	1.18	34,392	2,275,065	21.59
	9	2,337	919	----------	54,998	3,638,160	[4] 17.03

[1] Exchange rate of lira: 1925, 3.978 cents; 1926, 3.889 cents.
[2] Data not available.
[3] Produced 2,800 tons of ore, but no extraction of metal reported.
[4] Exclusive of the 26 workmen reported for the Roma district, for whom no output was reported.

Mercury exported from Italy, 1925–1927, by countries of destination, in quintals [1]

Destination	1925	1926	1927
Austria	298	81	65
France	961	1,042	851
Germany	3,003	4,069	2,874
Great Britain	2,086	1,718	1,674
Japan	1,511	2,599	1,421
Hong Kong	1,297	1,188	759
British India	960	1,087	599
United States	3,557	4,464	3,020
Other	1,401	1,837	2,209
	15,074	18,085	13,472

[1] Osborne, A. A., assistant commercial attaché, Rome, Italy, Economic and Trade Notes 67085, Mar. 21, 1928.

The addresses of the three leading dealers in mercury in Italy are: Monte Amiata, Società Anonima Mineraria, Corso Vittorio Emanuele 209, Rome (12); Stabilimento Minerario del Siele, Leghorn; and Società Mercurifera Italiana, Piazza Foro Traiano 51, Rome (2).

HAITI

Mercury is reported to have been found in the vicinity of Mole St. Nicholas.[20] The geology of the region is not favorable for finding mercury deposits of commercial importance.[21] Occurrences of cinnabar have been reported from time to time, but no detailed reports are available.

MEXICO

The continued high price of mercury during the past few years has greatly stimulated the mercury-mining industry in the Republic of Mexico. In 1926, 45.416 metric tons was produced, and in 1927, 81.515 tons, an increase of 79 per cent.

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[20] Ferguson, E. G. W., "The Mineral Resources of Haiti, West Indies": Min. World, vol. 31, 1909, pp. 133–135. Moreau de St. Méry, vol. 1, p. 104.

[21] Woodring, W. P., Brown, J. S., and Burbank, W. S., Geology of the Republic of Haiti: Republic of Haiti, Dept. of Public Works, Port au Prince, 1924, p. 424.

IRON ORE, PIG IRON, AND STEEL

By Hubert W. Davis [1]

GENERAL REVIEW

In 1927 the production and the shipments of iron ore decreased 9 and 12 per cent, respectively, as compared with 1926. The production ranked about with that of 1925 and was 103 per cent of the average for the preceding 5 years and 102 per cent of the average for the preceding 10 years. The output of pig iron, including ferro-alloys, decreased 7 per cent as compared with 1926 and was about 104 per cent of the average for the preceding 5 years and 108 per cent of the average for the preceding 10 years. The output of pig iron in 1927 was also about equal to that of 1925.

The average value per ton of iron ore at the mines in 1927 was 4 cents lower than in 1926, and that of pig iron at the blast furnaces declined $1.10 a ton. The quoted prices of ferromanganese and of steel were lower, but the price of spiegeleisen was higher. Earnings of 22 of the leading steel manufacturers in the United States, according to the Iron Trade Review,[2] showed a return on capitalization of 5.22 per cent in 1927 as compared with 6.86 per cent in 1926.

Compared with 1926, there was a considerable change in the proportions of steel taken by several important industries, according to Iron Age.[3] Agriculture and food containers each took about 5 per cent of the total in 1927, compared with 4 per cent in 1926. Out of a lower aggregate of steel produced exports gained through a slight advance in tonnage shipped. The oil and mining groups showed a falling off and the automotive industry a smaller drop. The railroads took much less than in 1926, while the building industry, maintaining its enormous stride of the preceding year, absorbed a considerably larger proportion of a smaller total tonnage.

The total domestic output of pig iron required about 72 per cent of the annual capacity, according to figures of the American Iron and Steel Institute, but this capacity was not utilized steadily. At the beginning of 1927 there were 210 furnaces in blast; on June 30 there were 193; and at the end of the year there were only 169. The production of steel ingots is considered to have been about 74 per cent of the capacity, having ranged from about 63 per cent in November to 91 per cent in March. The output of pig iron in the United States represented only about 43 per cent of the world's production and was about 18 per cent less than that of the producing countries of Europe combined. The production of these European countries increased about 30 per cent, compared with a decrease of 7 per cent in the United States.

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

[2] Hill, J. W., "Price heaviness causes sharp decline in 1927 steel profits": Iron Trade Rev., vol. 82, Mar. 29, 1928, pp. 812-814.

[3] Iron Age, "What steel was made and where it went in nineteen twenty-seven": Vol. 121, Jan. 5, 1928, pp. 6-9.

The iron-ore mining industry in the Lake Superior district was less active in 1927 than in 1926, although it was above the average for the preceding five years. Eastern furnaces took about 813,000 tons of Lake ore in 1927; they bought chiefly foreign ores, which they could get more cheaply. A computation of iron-mining profits in Michigan in 1927, made by the State mine appraiser, shows that the operators' net profit at underground mines was 21.3 cents a ton, whereas the net loss at siliceous open-pit mines was 3.6 cents a ton. These figures are probably representative of the entire Lake Superior district and show the ability of the operators, in the face of a maintained wage scale, to effect economies in an industry already highly specialized and efficient. The season of 1927 ended with stock piles larger than at the close of 1926. The total increase in stocks in the Lake Superior district amounted to 8 per cent.

IRON ORE

QUANTITIES MINED AND SHIPPED IN 1927

In the accompanying table the quantities of iron ore shown include ore that was beneficiated—that is, treated in any way—as well as crude ore not requiring treatment. The figures on both production and shipments include the iron ore used for fluxing other metallic ores at smelters in the Western States, but the shipments do not include the iron ore sold for the manufacture of paint, which amounted to 22,342 gross tons in 1927, valued at $132,007, or $5.91 a ton, compared with 21,167 tons in 1926, valued at $129,541, or $6.12 a ton. The output of manganiferous iron ore (including ore used for flux) that contained 5 per cent or more of manganese amounted to 1,461,608 gross tons, valued at $3,947,016, as compared with 1,217,431 tons, valued at $3,138,489, in 1926. In Arkansas one producer shipped a small quantity of loadstone, which is not included in the tabulated statistics of iron ore. Neither do the statistics include iron sinter recovered from copper sulphide ore, 45,983 gross tons of which, carrying more than 63 per cent of iron, was made in Tennessee in 1927.

Iron ore was mined in 18 States in 1927, as compared with 19 States in 1926, California having dropped out. All the iron ore produced in Montana and a small quantity of that produced in Utah was used for flux; a small quantity of ore from New Jersey and Virginia was used for purifying gas; all the output from Washington was used in the manufacture of ferromagnesite; the ore produced in the remaining States was mainly for use in blast furnaces; small quantities produced in Michigan, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin were used for paint. The rank of the three States producing the largest quantity of iron ore—Minnesota, Michigan, and Alabama—remained unchanged. Minnesota is producing more iron ore than all the rest of the States together, and has furnished a little more than 60 per cent of the total for the United States in the last five years.

The ores of iron are classed under the four heads—hematite, brown ore, magnetite, and carbonate.[4]

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[4] Notes on the composition of these ores are given in Mineral Resources, 1916, pt. 1, 1918, pp. 537-541.

Iron ore mined in the United States, 1926–27, by States and varieties, in gross tons

[Exclusive of ore containing 5 per cent or more of manganese]

State	Number of active mines	Hematite	Brown ore	Magnetite	Carbonate	Total
1926						
Alabama	21	6, 205, 451	642, 338			6, 847, 789
California	1			282		282
Colorado	1		35, 535			35, 535
Georgia	5		51, 642			51, 642
Michigan	68	15, 248, 254				15, 248, 254
Minnesota	90	40, 701, 613				40, 701, 613
Missouri	3	120, 000	4, 371			124, 371
Montana	4		724			724
New Jersey	2			209, 117		209, 117
New Mexico	1			216, 269		216, 269
New York	8	([1])		[1] 638, 849		638, 849
North Carolina	2		400	14, 798		15, 198
Pennsylvania	4		1, 140	1, 092, 150	2, 215	1, 095, 505
Tennessee	6	108, 040	30, 779			138, 819
Utah	4	[2] 275, 567	[2] 17, 321	2, 121		295, 009
Virginia	2	22, 485	26, 674			49, 159
Washington	1			1, 702		1, 702
Wisconsin	6	1, 322, 776				1, 322, 776
Wyoming	1	630, 387				630, 387
	233	[1] [2] 64, 634, 573	[2] 810, 924	[1] 2, 175, 288	2, 215	67, 623, 000
1927						
Alabama	23	5, 859, 304	586, 160			6, 445, 464
Colorado	1		32, 206			32, 206
Georgia	5		50, 312			50, 312
Michigan	70	15, 075, 079				15, 075, 079
Minnesota	95	35, 461, 138				35, 461, 138
Missouri	2	78, 605				78, 605
Montana	5	([2])	[2] 2, 837			2, 837
New Jersey	2			220, 660		220, 660
New Mexico	1			214, 747		214, 747
New York	[3] 6	([1])		[1] 853, 159		853, 159
North Carolina	1			32, 528		32, 528
Pennsylvania	3			1, 167, 942	2, 493	1, 170, 435
Tennessee	6	87, 373	34, 541			121, 914
Utah	2	[2] 221, 009	[2] 1, 870			222, 879
Virginia	2	29, 040	35, 552			64, 592
Washington	1			550		550
Wisconsin	6	1, 091, 118				1, 091, 118
Wyoming	1	602, 877				602, 877
	[3] 232	[1] [2] 58, 505, 543	[2] 743, 478	[1] 2, 489, 586	2, 493	61, 741, 100

[1] Some hematite included with magnetite.
[2] Some hematite included with brown ore.
[3] Apparent decrease due to change in method of counting mines in New York.

Iron ore mined in the United States, by mining districts and varieties, 1926–27, in gross tons

[Exclusive of ore containing 5 per cent or more of manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
1926					
Lake Superior [1]	57, 143, 407				57, 143, 407
Birmingham	6, 114, 917	393, 300			6, 508, 217
Chattanooga	198, 574	68, 550			267, 124
Adirondack Northern New Jersey and southeastern New York			[2] 847, 966		847, 966
Other districts	[2] [3] 1, 177, 675	[3] 349, 074	1, 327, 322	2, 215	[2] 2, 856, 286
	[2] [3] 64, 634, 573	[3] 810, 924	[2] 2, 175, 288	2, 215	67, 623, 000
1927					
Lake Superior [1]	51, 539, 880				51, 539, 880
Birmingham	5, 857, 326	437, 487			6, 294, 813
Chattanooga	89, 351	70, 897			160, 248
Adirondack Northern New Jersey and southeastern New York			[2] 1, 073, 819		[2] 1, 073, 819
Other districts	[2] [3] 1, 018, 986	[3] 235, 094	1, 415, 767	2, 493	[2] 2, 672, 340
	[2] [3] 58, 505, 543	[3] 743, 478	[2] 2, 489, 586	2, 493	61, 741, 100

[1] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[2] Some hematite from "Other districts" included with magnetite from Adirondack district.
[3] Some hematite included with brown ore.

The Lake Superior district, which comprises Minnesota, Michigan, and northern Wisconsin, mined a little more than 83 per cent of the total ore produced in 1927, and the Birmingham district mined a little more than 10 per cent. The Adirondack and northern New Jersey and southeastern New York districts were the only ones that produced more ore in 1927 than in 1926.

The following table shows the production of iron ore in the United States so far as it has been recorded or estimated. The figures for the years prior to 1860 are not strictly accurate, as they were calculated from the pig iron produced and included both imported and domestic ore. Details for 1880 to 1916 may be found in Mineral Resources for 1916.

Iron ore mined in the United States, 1810–1927, in gross tons

[Exclusive after 1905 of ore containing 5 per cent or more of manganese]

Year	Hematite	Brown ore	Magnetite	Carbonate	Total
1810–1869					49,656,000
1870 [1]–1880					51,690,889
1881–1890					103,854,386
1891–1900	136,961,046	22,845,764	14,634,364	1,065,137	175,506,311
1901–1910	364,179,432	[2] 28,287,994	[2] 20,664,453	262,366	413,394,245
1911–1915	239,419,251	8,355,102	10,156,539	42,495	257,973,387
1916	70,728,024	1,904,484	2,533,364	1,800	75,167,672
1917	70,743,513	1,992,332	2,553,006		75,288,851
1918	65,894,709	1,613,844	2,149,725		69,658,278
1919	[3] 57,719,582	1,127,397	[3] 2,118,439		60,965,418
1920	[3] [4] 63,883,523	[4] 1,325,661	[3] 2,391,541	3,740	67,604,465
1921	[3] [4] 28,337,249	[4] 370,154	[3] 780,866	2,709	29,490,978
1922	[4] 44,888,723	[4] 783,582	1,452,966	3,256	47,128,527
1923	[4] 65,924,454	[4] 1,232,848	2,190,624	3,516	69,351,442
1924	[4] 52,102,300	[4] 814,159	1,347,711	3,249	54,267,419
1925	[4] 59,546,690	[4] 884,600	1,472,004	4,703	61,907,997
1926	[4] [5] 64,634,573	[4] 810,924	[5] 2,175,288	2,215	67,623,000
1927	[4] [5] 58,505,543	[4] 743,478	[5] 2,489,586	2,493	61,741,100
					1,792,270,365

[1] Includes ore produced by owners of blast furnaces, estimated by census at 800,000 tons.
[2] Some brown ore included with magnetite.
[3] Some magnetite included with hematite.
[4] Some hematite included with brown ore.
[5] Some hematite included with magnetite.

The ore reported as sold for flux other than that used in the smelting of pig iron amounted to 17,287 gross tons, valued at $26,051, as compared with 51,934 tons, valued at $72,703, in 1926. The ore reported sold for purifying gas amounted to 1,361 gross tons, valued at $8,261, as compared with 3,605 tons, valued at $26,217, in 1926. The domestic iron ore sold for the manufacture of pig iron amounted to 61,213,275 gross tons, valued at $151,087,933, as compared with 69,235,591 tons, valued at $173,912,045, in 1926.

Iron ore shipped from mines in the United States, 1926–27, by States

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	1926		1927	
	Gross tons	Value	Gross tons	Value
Alabama	6,871,412	$13,846,656	6,508,419	$12,973,597
California	282	(1)	------	------
Colorado	35,535	(1)	32,206	(1)
Georgia	51,642	149,198	50,312	147,068
Michigan	16,699,984	43,932,982	14,532,831	37,135,364
Minnesota	40,961,361	103,715,621	35,563,177	87,935,099
Missouri	124,371	532,536	78,605	315,670
Montana	724	1,810	2,837	10,156
New Jersey	212,152	925,403	202,720	860,393
New Mexico	216,269	(1)	214,747	(1)
New York	659,741	3,015,586	936,850	4,568,224
North Carolina	14,798	31,645	32,528	81,753
Pennsylvania	1,088,634	2,483,056	1,124,883	2,559,916
Tennessee	138,307	312,109	121,220	274,620
Utah	296,943	411,611	222,879	(1)
Virginia	49,703	162,446	66,897	172,877
Washington	1,702	(1)	550	(1)
Wisconsin	1,238,885	3,178,156	937,935	2,567,078
Wyoming	630,387	(1)	602,877	(1)
Undistributed	------	[2] 1,316,830	------	[2] 1,524,005
	69,292,832	174,015,645	61,232,473	151,125,820

[1] Included under "Undistributed."

[2] This figure includes value for States entered as "(1)" above.

Iron ore shipped from mines in the United States, 1918–1927

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

Year	Gross tons	Value	Year	Gross tons	Value
1918	72,021,202	$244,368,147	1923	69,811,472	$240,738,921
1919	56,372,784	197,312,517	1924	52,083,375	151,307,105
1920	69,281,341	285,006,327	1925	63,924,763	160,796,886
1921	26,652,528	89,745,308	1926	69,292,832	174,015,645
1922	50,612,620	157,809,286	1927	61,232,473	151,125,820

PRINCIPAL IRON-ORE MINES

In 1927, 232 iron-ore mines were active, compared with 233 in 1926 and 238 in 1925; 131 mines produced more than 100,000 gross tons of iron ore each, compared with 140 in 1926 and 130 in 1925. Of these 131 mines 10 (6 in Minnesota, 2 in Alabama, 1 in Michigan, and 1 in Pennsylvania) produced more than 1,000,000 tons each, compared with 12 (9 in Minnesota, 2 in Alabama, and 1 in Michigan) in 1926 and 10 (8 in Minnesota, 1 in Alabama, and 1 in Michigan) in 1925. The operators of all but one of these large mines have permitted the publication of output; the figures are given in the table that follows. The predominance of hematite as an iron ore is clearly shown by the fact that of these 131 large mines only 5 produced magnetite and 1 produced brown ore. The trend toward large mining units is shown in the production of more than 94 per cent of the output of the country by the 131 mines, which yielded more than 100,000 tons each. The 10 mines that produced more than 1,000,000 tons each in 1927 furnished 35 per cent of the total. The average production per mine in 1927 was 266,125 tons, as compared with 290,227 tons in 1926.

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1927

Rank	Name of mine	State	Nearest town	Variety of ore	Gross tons
1	Missabe Mountain	Minnesota	Virginia	Hematite	4,913,115
2	Red Mountain group	Alabama	Bessemer	do	3,162,432
3	Hull-Rust	Minnesota	Hibbing	do	2,979,903
4	Mahoning	do	do	do	2,222,309
5	Sellers	do	do	do	1,647,561
6	Adams-Spruce group	do	Eveleth	do	1,628,976
7	Norrie group	Michigan	Ironwood	do	1,427,430
8	Morris	Minnesota	Hibbing	do	1,420,863
9	Woodward Nos. 1, 2, and 3	Alabama	Bessemer	do	1,146,965
10	Cornwall	Pennsylvania	Miners Village	Magnetite	1,088,041
11	Leonidas	Minnesota	Eveleth	Hematite	962,765
12	Hill Annex	do	Calumet	do	783,370
13	Morrison	do	Coleraine	do	749,988
14	Dunwoody	do	Chisholm	do	684,938
15	Newport (including Bonnie)	Michigan	Ironwood	do	679,412
16	Bennett	Minnesota	Keewatin	do	656,164
17	Fayal	do	Eveleth	do	641,898
18	Susquehanna	do	Hibbing	do	632,345
19	Sunrise	Wyoming	Sunrise	do	602,877
20	Ironton	Michigan	Bessemer	do	599,500
21	Witherbee, Sherman & Co. group	New York	Mineville	Magnetite	599,392
22	Sloss Nos. 1 and 2	Alabama	Bessemer	Hematite	589,106
23	Raimund Nos. 1 and 2	do	do	do	556,486
24	Pioneer	Minnesota	Ely	do	548,361
25	Plymouth	Michigan	Wakefield	do	542,705
26	Hill-Trumbull	Minnesota	Marble	do	516,385
27	Wakefield	Michigan	Wakefield	do	507,262
28	Montreal	Wisconsin	Montreal	do	506,293
29	Arcturus	Minnesota	Marble	do	487,934
30	Negaunee	Michigan	Negaunee	do	487,880
31	Wabigon	Minnesota	Buhl	do	477,454
32	Hawkins	do	Nashwauk	do	450,891
33	Chapin	Michigan	Iron Mountain	do	429,728
34	Sibley	Minnesota	Ely	do	429,286
35	North Harrison	do	Pengilly	do	424,694
36	La Rue	do	Nashwauk	do	418,112
37	Asteroid (including Eureka)	Michigan	Ramsay	do	415,305
38	Corsica	Minnesota	McKinley	do	404,112
39	Scranton	do	Hibbing	do	404,048
40	Cliffs Shaft	Michigan	Ishpeming	do	402,532
41	Shenango	Minnesota	Chisholm	do	380,001
42	Volunteer	Michigan	Palmer	do	373,473
43	Bristol (including Youngstown)	do	Crystal Falls	do	373,237
44	Boeing	Minnesota	Hibbing	do	372,902
45	Penn group	Michigan	Norway and Vulcan	do	372,118
46	Utica	Minnesota	Hibbing	do	364,584
47	St. Paul	do	Keewatin	do	363,479
48	Sunday Lake	Michigan	Wakefield	do	358,540
49	Zenith	Minnesota	Ely	do	345,063
50	Burt (including Pool and Day)	do	Hibbing	do	334,168
51	Biwabik (including Cincinnati)	do	Biwabik	do	329,945
52	Miller	do	Aurora	do	329,587
53	Morris-Lloyd	Michigan	Ishpeming	do	326,814
54	James	do	Iron River	do	318,371
55	Berkshire	do	Stambaugh	do	307,750
56	Kerr	Minnesota	Hibbing	do	306,441
57	Caspian	Michigan	Iron River	do	305,219
58	Danube	Minnesota	Bovey	do	302,762
59	South Agnew	do	Buhl	do	299,099
60	Alexandria	do	Chisholm	do	298,852
61	Lake Superior	Michigan	Ishpeming	do	293,694
62	Sargent	Minnesota	Keewatin	do	290,253
63	Harold	do	Stuntz	do	284,589
64	Lone Jack	do	Virginia	do	272,963
65	Maas	Michigan	Negaunee	do	270,006
66	Harrison	Minnesota	Pengilly	do	267,927
67	Armour No. 1	do	Crosby	do	260,948
68	Sauntry	do	Virginia	do	255,577
69	Palms	Michigan	Bessemer	do	254,796
70	Glen	Minnesota	Chisholm	do	253,571
71	Odgers	Michigan	Crystal Falls	do	251,900
72	Wellington	Minnesota	Chisholm	do	243,855
73	No. 5 Shaft	Wisconsin	Montreal	do	242,368
74	Bengal	Michigan	Iron River	do	238,622
75	Athens	do	Negaunee	do	232,748
76	Lincoln	Minnesota	Virginia	do	232,170
77	Balkan (including Judson)	Michigan	Alpha	do	230,841
78	Aragon	do	Norway	do	227,756
79	Albany	Minnesota	Hibbing	do	222,689
80	Maroco	do	Ironton	do	222,333
81	Desert Mound	Utah	Iron Springs	do	221,009

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1927—Continued

Rank	Name of mine	State	Nearest town	Variety of ore	Gross tons
82	Bruce	Minnesota	Chisholm	Hematite	219, 529
83	Mace No. 2	do	Nashwauk	do	216, 742
84	Union Hill (including Republic).	New Mexico	Fierro	Magnetite	214, 747
85	Baltic (including Fogarty and Buck).	Michigan	Iron River	Hematite	212, 012
86	Shiras	Minnesota	Buhl	do	211, 842
87	Armour No. 2 (including Cuyuna-Duluth).	do	Crosby	do	210, 320
88	Cary	Wisconsin	Hurley	do	209, 927
89	Rogers	Michigan	Iron River	do	206, 310
90	Chisholm	Minnesota	Chisholm	do	205, 563
91	Puritan	Michigan	Ironwood	do	202, 702
92	Riverton group	do	Iron River	do	201, 805
93	Keweenaw	do	Bessemer	do	195, 874
94	Richmond	do	Palmer	do	191, 357
95	Monongahela	do	Crystal Falls	do	182, 400
96	Shannon	Alabama	Birmingham	do	180, 342
97	Homer	Michigan	Iron River	do	180, 060
98	Holmes	do	Ishpeming	do	176, 494
99	Ogden	do	do	do	174, 106
100	Warner	do	Amasa	do	172, 153
101	(1)	(1)	(1)	(1)	171, 235
102	Wanless	Minnesota	Buhl	Hematite	169, 821
103	Higgins No. 2 (including MacEwen).	do	Virginia	do	168, 616
104	West Rust	do	Hibbing	do	164, 731
105	Zimmerman	Michigan	Gaastra	do	164, 579
106	Forbes	do	Iron River	do	164, 348
107	Soudan	Minnesota	Soudan	do	160, 884
108	Union	do	Virginia	do	157, 757
109	Virgil (including Spies)	Michigan	Iron River	do	156, 004
110	Mississippi	Minnesota	Keewatin	do	153, 974
111	Bates	Michigan	Iron River	do	152, 835
112	Croft	Minnesota	Crosby	do	145, 640
113	Cambria (including Lillie)	Michigan	Negaunee	do	145, 530
114	Irondale No. 2	Alabama	Irondale	do	143, 932
115	Shada	Minnesota	Nashwauk	do	143, 366
116	Wade	do	Kinney	do	141, 558
117	Davidson No. 1	Michigan	Iron River	do	140, 219
118	Mount Hope	New Jersey	Wharton	Magnetite	133, 625
119	Hiawatha	Michigan	Iron River	Hematite	133, 334
120	Kinney	Minnesota	Kinney	do	129, 604
121	Russellville	Alabama	Russellville	Brown ore	128, 088
122	Tilden	Michigan	Bessemer	Hematite	124, 315
123	Shaw	Minnesota	Virginia	do	122, 328
124	Archibald	Michigan	Gwinn	do	118, 929
125	Stephenson	do	do	do	109, 318
126	Mary Charlotte	do	Negaunee	do	107, 464
127	Imperial	do	Michigamme	do	107, 017
128	Davidson No. 2	do	Iron River	do	103, 140
129	Leetonia	Minnesota	Carson Lake	do	102, 851
130	York	do	Nashwauk	do	101, 211
131	Townsite	Michigan	Ironwood	do	100, 025
	Total (131 mines)				58, 292, 401
	Output of 34 mines producing between 50,000 and 100,000 gross tons each				2, 516, 848
	Output of 67 mines producing less than 50,000 gross tons each				931, 851
	Grand total of United States (232 mines)				61, 741, 100

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[1] Bureau of Mines not at liberty to publish identification.

STOCKS OF ORE AT MINES

According to the reports of producers, the total quantity of iron ore in stock at the mines at the end of 1927 amounted to 10,104,673 gross tons, compared with 9,565,880 tons at the end of 1926, an increase of nearly 6 per cent. As the quantity of ore in stock piles is of necessity partly estimated, resulting variations in the mine reports from year to year prevent an absolute balance between the quantity mined, the quantity shipped, and the stocks on hand. The reported stocks at the end of 1927 were about 588,000 tons below the average for the preceding five years and, except in 1926, are the lowest since 1918.

Stocks of iron ore at mines December 31, 1926 and 1927, by States, in gross tons

State	1926	1927	State	1926	1927
Alabama	912, 702	848, 850	New York	214, 522	116, 774
Iowa	12, 165	12, 165	Pennsylvania	42, 263	85, 322
Michigan	5, 527, 102	6, 089, 053	Virginia	25, 929	22, 060
Minnesota	2, 505, 982	2, 518, 000	Wisconsin	175, 629	243, 585
Missouri	2, 629	2, 629			
New Jersey	146, 957	166, 235		9, 565, 880	10, 104, 673

VALUE OF ORE PER TON

The table that follows gives the average value at the mines of the different classes of iron ore in 1926 and 1927 for each of the producing States or groups of States except where the shippers of a certain variety of ore in a State were less than three and permission was not given to publish the value. These figures are taken directly from statements of the producers and probably represent the commercial selling prices only approximately, as all the reports are not consistent. Some of them evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking fund; and still others include only the costs charged against the blast furnaces. None of the reports, however, is supposed to include freight charges.

Average value per gross ton of iron ore at mines in the United States, 1926–27

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1926	1927	1926	1927	1926	1927
Alabama	$1.94	$1.93	$2.74	$2.58	-----	-----
Georgia	-----	-----	2.89	2.92	-----	-----
Michigan	2.63	2.56	-----	-----	-----	-----
Minnesota	2.53	2.47	-----	-----	-----	-----
Missouri	4.31	4.02	(1)	-----	-----	-----
Montana	-----	(2)	2.50	[2]3.58	-----	-----
New Jersey	-----	-----	(1)	(1)	(1)	$4.23
New York	-----	-----	-----	-----	$4.57	4.88
North Carolina	-----	-----	-----	-----	2.14	2.51
Pennsylvania	-----	-----	(1)	-----	2.27	2.28
Tennessee	2.00	2.10	3.15	2.69	-----	-----
Virginia	3.00	2.82	3.50	2.38	-----	-----
Wisconsin	2.57	2.74	-----	-----	-----	-----
Other States [3]	1.25	1.21	3.19	2.99	3.11	1.98
	2.49	2.43	2.83	2.62	3.13	3.38

[1] Less than three producers; permission to publish not given, therefore value may not be shown.

[2] Value for hematite included with brown ore.

[3] 1926: California, Colorado, New Jersey, New Mexico, Utah, Washington, and Wyoming; 1927: Colorado, New Mexico, Utah, Washington, and Wyoming.

The following table summarizes the average value of iron ore at the mines from 1915 to 1927. Not until 1917 did the average value rise above $3 a ton, and the average for 1920, $4.11, is the highest on record.

Average value per gross ton of iron ore at mines in the United States, 1915–1927

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

Year	Hematite	Brown ore	Magnetite	Carbonate	General average [1]
1915	$1.80	$1.80	$2.50	$2.44	$1.83
1916	2.32	2.03	3.11	3.00	2.34
1917	3.12	2.95	4.29	----------	3.15
1918	3.35	3.51	4.60	----------	3.39
1919	3.48	3.63	4.08	----------	3.50
1920	4.09	4.19	4.59	(2)	4.11
1921	3.37	2.63	3.61	(2)	3.37
1922	3.14	2.65	2.37	(2)	3.12
1923	3.46	2.88	3.34	(2)	3.45
1924	2.91	2.75	2.95	(3)	2.91
1925	2.50	2.78	3.07	(3)	2.52
1926	2.49	2.83	3.13	(2)	2.51
1927	2.43	2.62	3.38	(2)	2.47

[1] Average values in 1889 and 1892–1914 are given in Mineral Resources for 1919 and many earlier volumes.

[2] Sold for paint and not included in shipments of iron ore.

[3] Carbonate of iron, used in making pig iron, was sold by one producer in Ohio in 1924 and 1925; that from Pennsylvania was sold for paint.

IRON ORE CONSUMED

The furnaces in Alabama in making 1 ton of pig iron consumed in 1927 an average of 2.371 tons of ore, the highest average for any State. The greater part of the iron ore used in Alabama furnaces in 1927 was hematite from mines in Jefferson County, Ala.; small quantities of hematite from Etowah County, Ala., and from the Lake Superior district were also used. The brown ore used was obtained chiefly from mines in the Birmingham and Russellville districts, Alabama, and the Cedartown district, Georgia, and the manganiferous iron ore was chiefly from mines in Alabama, Arkansas, Georgia, and Virginia.

In 1927 the furnaces in Maryland used only foreign ores, obtained chiefly from Chile and Cuba, although some were obtained from Algeria, France, Morocco, Spain, and Sweden. The Maryland furnaces consumed an average of only 1.366 tons of ore in making 1 ton of pig iron in 1927, but they used proportionately more cinder, scale, and scrap than the furnaces in Alabama.

The furnaces in Indiana, Kentucky, Michigan, Minnesota, and West Virginia used Lake Superior iron ore and manganiferous iron ore exclusively in 1927; the furnaces in Ohio used, in addition to some magnetite from New York, ore chiefly from the Lake Superior district; and the furnaces in Wisconsin used ore from mines in the Lake Superior district and from the Mayville mine in southern Wisconsin. In 1927 the consumption of ores per ton of iron made ranged from 1.524 tons in Kentucky to 1.839 tons in West Virginia.

The furnaces in the Chicago district, including Joliet, Ill., used iron ore and manganiferous iron ore from mines in the Lake Superior district; those at Granite City, Ill., used ore chiefly from mines in the Lake Superior district and in addition used ore from the Iron Mountain and Rueppele mines in Missouri. An average of 1.79 tons of ore was used to make 1 ton of pig iron in 1927.

In New York the furnaces in the Buffalo district used ores from the Lake Superior district and from Mineville, N. Y.; the furnace at Charlotte used Lake Superior iron ores; the furnaces at Port Henry used magnetite from the New Bed, Old Bed, and Harmony mines at

Mineville, N. Y.; the furnace at Standish used magnetite from the Chateaugay mine at Lyon Mountain, N. Y.; and the furnace at Troy used, in addition to a little Lake ore, magnetites from the Old Bed, New Bed, Harmony, and No. 21 mines at Mineville, N. Y., and the Forest of Dean mine at Fort Montgomery, N. Y. In making 1 ton of pig iron the furnaces in New York used an average of 1.863 tons of ore in 1927.

The furnaces in western Pennsylvania used ores mostly from the Lake Superior district. Those in the eastern part of the State used, in addition to some Lake ores, magnetites from the Cornwall and French Creek mines in Pennsylvania; magnetites from the Cannon, Peters, Mount Hope, and Richard mines in New Jersey; magnetites from the Chateaugay, New Bed, Old Bed, Harmony, No. 21, and Forest of Dean mines in New York; and considerable quantities of ores from Africa, Brazil, Canada, Chile, Cuba, Spain, and Sweden. An average of 1.73 tons of ore was used in Pennsylvania in 1927 to make 1 ton of pig iron.

The iron furnaces in Tennessee used brown ore from Wrigley and Bon Aqua, Tenn.; hematite from the Rockwood area, Tenn.; magnetite from the Cranberry mine in North Carolina; brown ore from the Bartow and Reed mines in Georgia and from the Taits Gap mines in Alabama; and manganiferous iron ore from Georgia and Tennessee, as well as some ores from Algeria and Sweden. An average of 2.039 tons of ore was used per ton of iron made in 1927.

Virginia iron furnaces used chiefly local hematite and brown ore. These furnaces used 0.715 ton of cinder, scale, and scrap to 1 ton of pig iron, the highest average for any State. The consumption of ore per ton of iron made was 1.353 tons in 1927.

The blast furnaces at Pueblo, Colo., used brown ore from the Orient mine in Colorado, hematite from the Sunrise mine in Wyoming and from the Desert Mound mine in Utah, magnetite from the Union Hill mine in New Mexico, and manganiferous iron ores from Leadville, Colo., and Silver City, N. Mex.

The blast furnace at Provo, Utah, used some iron ore from the Iron King mine, near Eureka, Utah, but by far the greater part was obtained from the Desert Mound mine in the Iron Springs district, Utah. The manganiferous iron ore used was obtained from Idaho, Montana, and Nevada.

The furnace at Everett, Mass., used some magnetite from Mineville, N. Y., and some ore from the Lake Superior district, but the greater part of the ore used was from Africa, Newfoundland, and Sweden.

The following two tabulations show the consumption of iron ore and other metallic materials, the production of pig iron (as reported to the Bureau of Mines), and the average quantities of materials used per ton of pig iron made:

Iron ore and other metallic materials consumed and pig iron produced in 1927, by States, in gross tons

State	Metalliferous materials consumed				Pig iron produced, exclusive of ferro-alloys	Materials consumed per ton of iron made		
	Iron and manganiferous iron ores		Cinder, scale, and scrap	Total		Ores	Cinder, scale, and scrap	Total
	Domestic	Foreign						
Alabama	6, 543, 634	6, 064	330, 290	6, 879, 988	2, 762, 810	2. 371	0. 119	2. 490
Colorado	(1)		(1)	(1)	(1)	(1)	(1)	(1)
Illinois	6, 450, 859		462, 265	6, 913, 124	3, 604, 891	1. 790	. 128	1. 918
Indiana	6, 146, 320		579, 169	6, 725, 489	3, 451, 003	1. 781	. 168	1. 949
Kentucky	261, 639		51, 017	312, 656	171, 698	1. 524	. 297	1. 821
Maryland		1, 168, 501	232, 147	1, 400, 648	855, 566	1. 366	. 271	1. 637
Massachusetts	54, 526	227, 223	20, 529	302, 278	175, 244	1. 608	. 117	1. 725
Michigan	1, 298, 909		84, 201	1, 383, 110	747, 820	1. 737	. 113	1. 850
Minnesota	496, 114		73, 657	569, 771	300, 002	1. 654	. 245	1. 899
New York	4, 542, 329		222, 562	4, 764, 891	2, 437, 954	1. 863	. 091	1. 954
Ohio	14, 365, 482		1, 488, 100	15, 853, 582	8, 407, 317	1. 709	. 177	1. 886
Pennsylvania	18, 705, 210	1, 128, 690	1, 896, 953	21, 730, 853	11, 465, 481	1. 730	. 165	1. 895
Tennessee	223, 476	10, 080	31, 189	264, 745	114, 570	2. 039	. 272	2. 311
Utah	(1)			(1)	(1)	(1)	(1)	(1)
Virginia	116, 239		61, 480	177, 719	85, 935	1. 353	. 715	2. 068
West Virginia	966, 475		22, 527	989, 002	525, 486	1. 839	. 043	1. 882
Wisconsin	(1)		(1)	(1)	(1)	(1)	(1)	(1)
Undistributed	[2] 1, 547, 171		[2] 45, 920	[2] 1, 593, 091	[2] 769, 352	[2] 2. 011	[2] . 060	[2] 2. 071
	61, 718, 383	2, 540, 558	5, 602, 006	69, 860, 947	35, 875, 129	1. 791	. 156	1. 947

[1] Included under "Undistributed."
[2] Includes figures for States entered as "(1)" above.

Iron ore and other metallic materials consumed and pig iron produced in the United States, 1918–1927, in gross tons

Year	Metalliferous materials consumed				Pig iron produced, exclusive of ferro-alloys	Materials consumed per ton of iron made			
	Iron and manganiferous iron ores		Cinder, scale, and scrap	Total		Ores		Cinder, scale, and scrap	Total
	Domestic	Foreign				Domestic	Foreign		
1918	69, 905, 547	690, 145	5, 343, 963	75, 939, 655	38, 130, 786	1. 833	0. 018	0. 140	1. 991
1919	54, 950, 623	520, 785	3, 721, 448	59, 192, 856	30. 508, 122	1. 801	. 017	. 122	1. 940
1920	64, 671, 894	968, 313	5, 650, 128	71, 290, 335	36, 242, 748	1. 784	. 027	. 156	1. 967
1921	28, 847, 395	372, 038	2, 269, 864	31, 489, 297	16, 403, 627	1. 759	. 023	. 138	1. 920
1922	46, 485, 690	910, 205	4, 285, 187	51, 681, 082	26, 826, 210	1. 733	. 034	. 160	1. 927
1923	69, 272, 579	2, 084, 094	5, 376, 448	76, 733, 121	39, 767, 482	1. 742	. 052	. 135	1. 929
1924	51, 880, 562	2, 012, 689	4, 646, 320	58, 539, 571	30, 869, 199	1. 681	. 065	. 150	1. 896
1925	62, 029, 734	2, 337, 767	5, 137, 068	69, 504, 569	36, 124, 678	1. 717	. 065	. 142	1. 924
1926	65, 922, 601	2, 442, 631	6, 254, 523	74, 619, 755	38, 755, 698	1. 701	. 063	. 161	1. 925
1927	61, 718, 383	2, 540, 558	5, 602, 006	69, 860, 947	35, 875, 129	1. 720	. 071	. 156	1. 947

Foreign iron and manganiferous iron ores consumed in the manufacture of pig iron in the United States, 1926–27, by sources of ore, in gross tons

Source of ore	1926	1927	Source of ore	1926	1927
Africa	209, 431	379, 494	Russia	301	
Brazil	930	875	Spain	121, 823	101, 393
Canada	27, 950	3, 094	Sweden	190, 696	233, 027
Chile	1, 203, 616	1, 186, 904	Undistributed	3, 715	135, 012
Cuba	666, 440	420, 671			
France	7, 250	5, 643		2, 442, 631	2, 540, 558
Newfoundland	10, 479	74, 445			

LAKE SUPERIOR DISTRICT

PRODUCTION

The total quantity of iron ore mined in the Lake Superior district, not including the Iron Ridge area in Wisconsin, decreased 10 per cent in 1927. The output of the several ranges is shown in the table that follows. After 1905 the figures do not include manganiferous iron ore containing 5 per cent or more of manganese; 1,300,084 gross tons of this ore was mined in 1927, compared with 1,065,419 tons in 1926. The Mesabi range produced 64 per cent of the iron-ore output of the Lake Superior district and 53 per cent of the total output of the United States in 1927. The proportion contributed by this range has been remarkably uniform since 1915 but was slightly less than the average in 1927. Production decreased on all the iron ranges except the Menominee and Vermilion; the decrease on the Mesabi range was the largest, and that on the Marquette range was the smallest.

Iron ore mined in the Lake Superior district, 1854–1927, in gross tons

[Exclusive after 1905 of ore containing 5 per cent or more of manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1870	3, 971, 716	------------	------------	------------	------------	------------	3, 971, 716
1871–1880	10, 294, 047	858, 810	------------	------------	------------	------------	11, 152, 857
1881–1890	18, 598, 012	11, 917, 416	8, 657, 807	3, 260, 426	------------	------------	42, 433, 661
1891–1900	27, 269, 545	21, 639, 872	23, 361, 043	12, 097, 048	32, 282, 873	------------	116, 650, 381
1901–1910	37, 728, 143	41, 974, 789	34, 514, 899	15, 350, 581	194, 654, 902	------------	324, 223, 314
1911–1915	18, 404, 620	21, 862, 454	21, 366, 821	7, 234, 387	142, 721, 213	3, 191, 627	214, 781, 122
1916	4, 792, 987	6, 649, 578	7, 707, 101	1, 704, 440	41, 325, 341	1, 555, 641	63, 735, 088
1917	4, 638, 374	6, 366, 483	7, 881, 232	1, 481, 301	41, 127, 323	1, 986, 608	63, 481, 321
1918	3, 946, 554	6, 041, 637	7, 837, 634	1, 192, 677	39, 055, 977	1, 705, 315	59, 779, 794
1919	4, 158, 751	4, 863, 968	7, 368, 994	1, 051, 795	33, 262, 954	1, 685, 877	52, 392, 339
1920	4, 457, 609	5, 651, 542	8, 298, 206	1, 053, 518	36, 641, 880	1, 757, 775	57, 860, 530
1921	2, 204, 114	2, 147, 569	3, 135, 477	981, 576	16, 380, 190	449, 559	25, 298, 485
1922	2, 745, 626	3, 290, 641	4, 910, 789	1, 108, 764	26, 704, 601	955, 595	39, 716, 016
1923	3, 910, 909	4, 913, 541	6, 112, 662	1, 119, 113	41, 809, 018	1, 420, 165	59, 285, 408
1924	3, 579, 087	3, 780, 664	5, 579, 883	1, 141, 690	29, 818, 965	941, 430	44, 841, 719
1925	3, 813, 687	5, 009, 022	6, 377, 710	1, 331, 753	34, 851, 109	673, 382	52, 056, 663
1926	4, 046, 191	5, 445, 683	6, 949, 920	1, 568, 953	37, 997, 797	1, 134, 863	57, 143, 407
1927	4, 015, 730	5, 458, 182	6, 604, 830	1, 577, 817	32, 866, 034	1, 017, 287	51, 539, 880
	162, 575, 702	157, 871, 851	166, 665, 008	53, 255, 839	781, 500, 177	18, 475, 124	1, 340, 343, 701

SHIPMENTS AND RECEIPTS

According to the Lake Superior Iron Ore Association, 52,344,099 gross tons of iron ore and manganiferous iron ore was shipped in 1927 from the Lake Superior district, including the Iron Ridge area in Wisconsin, as compared with 59,970,009 tons in 1926. The shipments, as reported to the Bureau of Mines by producers, amounted to 51,038,403 gross tons of iron ore and 1,300,084 tons of manganiferous iron ore containing 5 per cent or more of manganese, a total of 52,338,487 tons in 1927, compared with 58,904,908 tons of iron ore and 1,065,419 tons of manganiferous iron ore, a total of 59,970,327 tons in 1926.

The iron ore received at Lake Erie ports, according to the Marine Review, amounted to 36,552,791 gross tons and at Lake Michigan ports 12,112,634 gross tons, a total of 48,665,425 tons in 1927, compared with 43,191,577 tons at Lake Erie ports and 13,888,541 tons at Lake Michigan ports, a total of 57,080,118 tons in 1926. Detailed figures of shipments and receipts by ports and by months for recent years can be found in the Marine Review.

STOCKS OF ORE AT LAKE ERIE PORTS

Stocks of iron ore at lower Lake ports at the end of the shipping season are important because of their bearing on the manufacture of pig iron during the following winter and spring. According to the Marine Review, at the close of navigation in 1927, 6,944,315 gross tons of ore was in stock at Lake Erie ports, compared with 7,662,800 tons at the corresponding date in 1926. At the opening of navigation in May, 1928, 5,182,388 tons of ore was in stock at these ports, indicating a withdrawal of 1,761,927 tons during the winter of 1927–28. The average quantity withdrawn each winter during the preceding five winters was about 3,941,000 tons. Detailed statistics concerning these stocks by ports can be found in the Marine Review

PRICES OF LAKE SUPERIOR ORE

The price of iron ore per unit of iron in the natural state for the four standard grades of Lake Superior ore for the last 14 years is shown in the Iron Trade Review.[5] The base of Bessemer ore, old-range and Mesabi, for 1927, 1926, and 1925 is a metallic iron content of 51.5 per cent, natural, instead of 55 per cent as for 1924 and many earlier years. The base of non-Bessemer ore, old-range and Mesabi, remains as heretofore at 51.5 per cent, natural. The unit prices established April 8, 1927, are the same as those established March 17, 1926, and April 4, 1925, and are as follows: Old-range Bessemer, 8.835 cents; Mesabi Bessemer, 8.544 cents; old-range non-Bessemer, 8.544 cents; Mesabi non-Bessemer, 8.252 cents. The prices per ton that correspond to these unit prices are, respectively, $4.55, $4.40, $4.40, and $4.25. The prices for 1927, 1926, and 1925 are the lowest that have been in effect since the season of 1916. The lowest prices ever quoted for these ores were $2.60 for old-range Bessemer in 1897, $2.15 for Mesabi Bessemer in 1895, $1.85 for old-range non-Bessemer in 1898, and $1.75 for Mesabi non-Bessemer in 1898.

IRON-ORE RESERVES

Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of State Tax Commissioners, cover developed and prospective ore in the ground and ore in stock piles. These estimates show decreases from the previous year of about 34,619,000 gross tons in Minnesota and about 10,405,000 tons in Michigan.

Iron-ore reserves in Minnesota May 1, 1923–1927, in gross tons

Range	1923	1924	1925	1926	1927
Mesabi	1, 254, 861, 451	1, 275, 347, 126	1, 250, 086, 347	1, 233, 979, 351	1, 201, 054, 119
Vermilion	13, 688, 352	13, 169, 953	13, 539, 256	12, 382, 725	12, 126, 490
Cuyuna	43, 041, 100	46, 121, 021	52, 124, 561	51, 090, 529	49, 652, 592
	1, 311, 590, 903	1, 334, 638, 100	1, 315, 750, 164	1, 297, 452, 605	1, 262, 833, 201

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[5] Iron Trade Review, Apr. 14, 1927, p. 994.

Iron-ore reserves in Michigan January 1, 1924–1928, in gross tons

Range	1924	1925	1926	1927	1928
Gogebic	54, 949, 558	51, 646, 890	52, 131, 121	53, 342, 720	48, 681, 075
Marquette	70, 384, 149	68, 978, 647	67, 160, 777	63, 612, 812	60, 219, 781
Menominee (including Iron River and Crystal Falls districts)	66, 555, 393	67, 184, 024	69, 188, 118	67, 103, 492	64, 752, 677
	191, 889, 100	187, 809, 561	188, 480, 016	184, 059, 024	173, 653, 533

IRON-ORE MINING, BY STATES

LAKE SUPERIOR DISTRICT

The outstanding features of mining developments in the Lake Superior iron mining district are described in articles published in trade and mining journals.[6]

Michigan.—Mining activity on the Michigan iron ranges in 1927 was on a slightly reduced scale, as is shown by a production of 15,075,079 gross tons, compared with 15,248,254 tons in 1926. The production in 1927 was made by 70 mines in five counties, as the following table shows:

Iron ore mined in Michigan, 1926–27, by counties

County	1926		1927	
	Active mines	Gross tons	Active mines	Gross tons
Baraga	1	105, 610	1	107, 017
Dickinson	4	1, 174, 325	5	1, 120, 579
Gogebic	18	5, 756, 380	19	5, 601, 167
Iron	25	4, 271, 358	24	4, 337, 603
Marquette	20	3, 940, 581	21	3, 908, 713
	68	15, 248, 254	70	15, 075, 079

The ore reserves in Michigan on January 1, 1928, amounted to 173,653,533 gross tons, a decrease from the previous year of about 10,405,500 gross tons—evidence that new discoveries did not keep pace with production.

Only one mine in Michigan, the Norrie group in Gogebic County, produced more than 1,000,000 tons in 1927. Of the 70 active mines in Michigan in 1927, 50 yielded more than 100,000 tons each. The average production per mine in Michigan in 1927 was 215,358 tons, compared with 224,239 tons in 1926.

A report on the iron ore mines of Michigan for 1927, published by the geological survey division of the Michigan Department of Conservation,[7] shows that the average number of men employed per day was 11,173, the average number of days worked underground and in open pits was 268, the average daily wage was $4.828, the average yearly earning was $1,293.95, and the tons of ore mined per man per day was 5.05.

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[6] Hain, A. J., "Steel prices key to better day in iron ore industry": Iron Trade Rev., vol. 82, Jan. 5, 1928, pp. 25–28, 122; Woodbridge, D. E., "Iron": Eng. and Min. Jour., vol. 125, Jan. 21, 1928, pp. 94–95; Skillings' Mining Review (various issues).

[7] Pardee, F. G., and Osgood, W., General Statistics Covering Costs and Production of Michigan Iron Mines: Geological survey division, Department of Conservation (Lansing), 1928.

The following table on average per ton costs of mining iron ore at underground mines and at siliceous open pits has been condensed from statistics published in much greater detail by the geological survey division of the Michigan Department of Conservation:

Average per ton costs of mining iron ore at underground mines and at siliceous open pits in Michigan in 1927

Item	Underground					Siliceous open pits
	Dickinson	Gogebic	Iron	Marquette	Total	
Cost of mining	$2.0550	$1.6738	$1.2732	$1.7921	$1.5987	$0.5313
Deferred mining costs	.0383	.0946	.0760	.0606	.0756	.0550
Taxes	.2529	.2998	.1717	.2889	.2502	.0623
General overhead	.1690	.2293	.1987	.2515	.2194	.1579
Transportation	1.4551	1.6590	1.4685	1.4072	1.5254	1.3726
Marketing	.0384	.0248	.0741	.0903	.0593	.0941
Total ore cost	4.0087	3.9813	3.2622	3.8906	3.7286	2.2732
Lake Erie value per ton	4.2744	4.5054	3.9850	4.5465	4.3200	2.3501
Gross ore profit	.2657	.5241	.7228	.6559	.5914	.0769
Other ore costs	.3879	.4573	.5146	.2859	.3784	.1130
Net operators' profit	−.1222	.0668	.2082	.3700	.2130	−.0361

Minnesota.—Mining activities in Minnesota were on a considerably reduced scale in 1927, the production of 35,461,138 gross tons representing a decrease of 13 per cent from 1926. The output in 1927 was made by 95 mines in 3 counties, as shown by the following table:

Iron ore mined in Minnesota, 1926–27, by counties

County	1926		1927	
	Active mines	Gross tons	Active mines	Gross tons
Crow Wing	7	1,134,863	7	1,017,287
Itasca	22	7,263,016	20	6,467,507
St. Louis	61	32,303,734	68	27,976,344
	90	40,701,613	95	35,461,138

The reserves of iron ore in Minnesota on May 1, 1927, amounted to 1,262,833,201 gross tons, a decrease of 34,619,400 tons from the previous year, indicating that new ore discovered during the year apparently was not enough to keep pace with production.

The largest producing mine in Minnesota, as well as in the United States, in 1927 was the Missabe Mountain, an open-pit operation in St. Louis County, which yielded 4,913,115 gross tons. The Hull-Rust mine, also an open-pit operation in St. Louis County, which was the second largest producer in 1926 and which had been the leading producer of iron ore in the United States for a number of years prior to 1926, yielded 2,979,903 tons in 1927, but it dropped to third place. Of the 95 active mines in Minnesota in 1927, 64 yielded more than 100,000 tons each. The average production per mine in Minnesota in 1927 was 373,275 tons, compared with 452,240 tons in 1926.

Wisconsin.—The production of iron ore in Wisconsin in 1927 was 1,091,118 gross tons, a decrease of 18 per cent from 1926. This output was made by six mines in two counties, as shown by the following table:

Iron ore mined in Wisconsin, 1926–27, by counties

County	1926		1927	
	Active mines	Gross tons	Active mines	Gross tons
Dodge	2	129, 236	2	87, 455
Iron	4	1, 193, 540	4	1, 003, 663
	6	1, 322, 776	6	1, 091, 118

The chief producing mine in Wisconsin in 1927, as in 1926, was the Montreal mine in Iron County, which yielded 506,293 gross tons.

Iron-ore analyses.—The iron content of the ore shipped from the Lake Superior district in 1927 averaged 51.19 per cent, natural, compared with 51.75 per cent in 1926, showing how closely these ores are graded. The average iron content in 1927, however, is the lowest since 1902, the year in which average analyses were first compiled. The percentage of manganese, silica, and phosphorus increased somewhat.

The following table, compiled by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore shipped and shows the remarkable uniformity maintained during the last 10 years:

Average analyses of total tonnages of all grades of iron ore from all ranges of Lake Superior district, 1918–1927

Year	Gross tons	Fe (natural)	P	SiO_2	Mn	Moisture
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1918	61, 972, 871	51. 29	0. 104	8. 12	0. 87	11. 29
1919	46, 666, 878	51. 57	. 105	8. 04	. 73	11. 34
1920	57, 938, 428	51. 69	. 103	8. 13	. 77	11. 09
1921	22, 523, 989	52. 07	. 087	8. 23	. 62	10. 95
1922	43, 431, 294	51. 87	. 099	8. 23	. 76	10. 78
1923	60, 024, 176	51. 79	. 095	8. 22	. 79	10. 76
1924	43, 276, 165	51. 72	. 100	8. 45	. 76	10. 75
1925	54, 784, 355	51. 74	. 099	8. 42	. 82	10. 58
1926	59, 151, 368	51. 75	. 101	8. 35	. 80	10. 78
1927	51, 730, 711	51. 19	. 105	8. 60	. 84	11. 31

During this 10-year period the iron content ranged from 51.19 to 52.07 per cent, the phosphorus from 0.087 to 0.105 per cent, the silica from 8.04 to 8.6 per cent, the manganese from 0.62 to 0.87 per cent, and the moisture from 10.58 to 11.34 per cent. This uniformity does not, of course, indicate that the average grade of the available Lake Superior iron ore is not declining. The grade of shipments has been maintained by methods of beneficiation, which are ever becoming more elaborate, and by mixing ores from different deposits.

SOUTHEASTERN STATES

Alabama.—The production of iron ore in Alabama in 1927 amounted to 6,445,464 gross tons, a decrease of 6 per cent from 1926. This output was made by 23 mines in 8 counties, as the following table shows.

Iron ore mined in Alabama, 1926–27, by counties

County	1926		1927	
	Active mines	Gross tons	Active mines	Gross tons
Blount	3	148, 429	5	197, 446
Etowah	2	90, 534	1	1, 978
Franklin	1	232, 530	1	128, 088
Jefferson	8	6, 114, 917	7	5, 857, 326
Tuscaloosa	5	244, 871	5	240, 041
Calhoun	1	16, 508	1	20, 585
Cherokee	1		1	
Talladega	3		2	
	24	6, 847, 789	23	6, 445, 464

The ore produced in Blount County in 1927 was brown ore, all of which was washed; the iron content of the concentrates averaged 53 per cent, the manganese averaged 0.9 per cent, and the phosphorus averaged 0.3 per cent. The ore produced in Talladega County averaged about 50 per cent of iron. The brown ore concentrates from the Russellville district in Franklin County averaged 49 per cent of iron. Tuscaloosa County was the largest producer of brown ore in Alabama in 1927; the iron content of the concentrates ranged from 44.56 to 46.40 per cent and averaged 45.34 per cent.

Most of the ore mined in Alabama is hematite, much of which is self-fluxing or nearly so. Jefferson County is the chief producer of hematite; the iron content of that shipped in 1927 ranged from 32.38 to 39.28 per cent, natural, and averaged 36.19 per cent.

Georgia.—The production of iron ore in Georgia in 1927 was 50,312 gross tons, a decrease of nearly 3 per cent from 1926. This output was made by 5 mines in 2 counties, as shown by the following table:

Iron ore mined in Georgia, 1926–27, by counties

County	1926		1927	
	Active mines	Gross tons	Active mines	Gross tons
Bartow	1	11, 925	1	9, 305
Polk	4	39, 717	4	41, 007
	5	51, 642	5	50, 312

Practically all the ore from Georgia in 1927 was washed brown ore; the iron content of the concentrates averaged about 50 per cent. Most of this ore was mined from the Cedartown area in Polk County; the remainder was from the Cartersville district in Bartow County.

North Carolina.—The production of iron ore in North Carolina in 1927 amounted to 32,528 gross tons, all magnetite, and averaged about 42 per cent of iron, natural. The output of iron ore in North Carolina in 1927 was more than double that of 1926.

Tennessee.—Tennessee, which produced both hematite and brown ore in 1927, mined 121,914 gross tons, a loss of 12 per cent from 1926. This output was made by 6 mines in 5 counties, as shown by the following table:

Iron ore mined in Tennessee, 1926–27, by counties

County	1926		1927	
	Active mines	Gross tons	Active mines	Gross tons
Dickson [1]	1	8,302	1	8,552
Hickman [1]	1	13,608	1	22,047
Lawrence	1	8,869	1	3,942
Hamilton	1	108,040	1	87,373
Roane	2		2	
	6	138,819	6	121,914

[1] Separation by counties revised for 1926.

By far the greater part of the ore is hematite, mined near Rockwood and Kingston, Roane County. The iron content of the Rockwood ore averaged 35.93 per cent, natural, in 1927 and that of the Kingston ore averaged 42.1 per cent, natural. The brown ore mined in 1927 was from the Johnson mine in Hickman County, the Iron Hill mine in Dickson County, and the Van Leer mine in Lawrence County. The brown ore from these mines is hand picked, washed, and jigged, and the iron content of the concentrates recovered in 1927 averaged 52.3, 51.75, and 48 per cent, respectively. A small quantity of hematite used for paint was mined at a deposit near Ooltewah, Hamilton County, in 1927.

Virginia.—The production of iron ore in Virginia in 1927 was 64,592 gross tons, an increase of 31 per cent over 1926. This output consisted of 29,040 tons of hematite averaging 41 per cent of iron, natural, from the Cloverdale mine in Botetourt County and 35,552 tons of brown ore concentrates averaging 49 per cent of iron from the Porter mine in Wythe County. Some ore from stock pile at the Pittsville mine in Pittsylvania County was shipped during 1927, and a little ore from stock pile at the Oriskany mine in Botetourt County was shipped for use in gas purification.

MISSOURI

The output of iron ore in Missouri in 1927 amounted to 78,605 gross tons, a decrease of 37 per cent from 1926. The output in 1927 consisted of 31,000 tons of hematite averaging about 51 per cent of iron, natural, from the Rueppele mine in Franklin County and 47,605 tons of hematite concentrates averaging 51.26 per cent of iron from the Iron Mountain mine in St. Francois County. The ore from these mines in 1927 was shipped to the blast furnaces at Granite City, Ill. The Missouri production, however, was not enough to meet the requirement of these furnaces, the larger part of the ore they consumed being obtained from the Lake Superior district.

NORTHEASTERN STATES

New Jersey.—The production of iron ore in New Jersey in 1927 was 220,660 gross tons, an increase of nearly 6 per cent over 1926. The Mount Hope mine, near Wharton, Morris County, with an output of 133,625 tons of concentrates, was again the largest producer; the iron content of the magnetite concentrates shipped averaged 61.37 per cent. The Richard mine, also near Wharton, Morris County, produced 87,035 tons of magnetite concentrates; the concentrates shipped averaged 62.75 per cent of iron. Considerable magnetite concentrates from stock pile at the Cannon and Peters mines near Ringwood Manor, Passaic County, were shipped during 1927, and some ore from stock pile at the Ahles mine near Buttzville, Warren County, was sold for use in gas purification and in the manufacture of paint.

New York.—The production of iron ore in New York in 1927, amounting to 853,159 gross tons, was 34 per cent more than in 1926. Mining operations at the New Bed, Harmony, and Old Bed mines in Essex County were on a greatly increased scale in 1927, and they were the largest producers of magnetite in the State. Practically all the ore from these mines is sintered; the iron content averages about 64 per cent. The Chateaugay mine in Clinton County was also worked on an increased scale in 1927; the magnetite concentrates shipped averaged 62.33 per cent of iron and 0.006 per cent of phosphorus. The Forest of Dean mine in Orange county yielded about 27 per cent more magnetite concentrates in 1927 than in 1926; the concentrates shipped in 1927 averaged about 62 per cent of iron. The No. 21 mine in Essex County was again nonproductive in 1927, but considerable magnetite concentrates that averaged about 60 per cent of iron were shipped from stock pile. New York is the largest producer of iron ore for use in paint. This ore, known as Clinton hematite, was mined in 1927 in Oneida and Wayne Counties.

Pennsylvania.—Pennsylvania, the largest producer of magnetite in the United States, mined 1,170,435 gross tons of ore in 1927, an increase of 7 per cent over 1926. The production in Pennsylvania in 1927 was the largest since 1891 and reflects the increased operations at the Cornwall mine in Lebanon County, which yielded over 1,000,000 tons in 1927. Most of the ore from the Cornwall mine was shipped to Lebanon, Pa., where it was concentrated and sintered before being charged to the blast furnaces. The crude ore shipped from the Cornwall mine to Lebanon in 1927 averaged 37.7 per cent of iron, natural, whereas the iron content of the concentrated ore averaged 56.55 per cent. The magnetite from the French Creek mine near St. Peters, Chester County, was shipped to Birdsboro, Pa., where it was sintered; the iron content of the sinter made in 1927 averaged 56.27 per cent. Some carbonate ore for use in paint was mined in Carbon County in 1927.

WESTERN STATES

Colorado.—The production of brown iron ore in Colorado in 1927 was 32,206 gross tons, a decrease of 9 per cent from 1926. This ore was mined at the Orient mine in Saguache County and averaged, natural, 43.4 per cent of iron, 1.38 per cent of manganese, and 0.025 per cent of phosphorus.

New Mexico.—The production of iron ore, all magnetite, in New Mexico in 1927 was 214,747 gross tons, slightly less than in 1926.

The ore mined in New Mexico in 1927 was from the Union Hill mine near Fierro, Grant County, and averaged, natural, 51.01 per cent of iron and 0.65 per cent of manganese.

Utah.—The production of iron ore in Utah in 1927, amounting to 222,879 gross tons, was 24 per cent less than in 1926. Practically all the ore produced in Utah in 1927 was hematite from the Desert Mound mine near Iron Springs, Iron County, the ore from which averaged, natural, 52 per cent of iron, 0.027 per cent of manganese, and 0.183 per cent of phosphorus. The only other active mine in Utah in 1927 was the Iron King mine near Eureka, from which a small quantity of iron ore was mined and shipped.

Wyoming.—The production of iron ore in Wyoming in 1927 amounted to 602,877 gross tons, a decrease of 4 per cent from 1926. The output was from the Sunrise mine in Platte County. The ore is hematite; that shipped in 1927 averaged, natural, 54.5 per cent of iron, 0.05 per cent of manganese, and 0.075 per cent of phosphorus.

FOREIGN TRADE IN IRON ORE

IMPORTS AND EXPORTS

The iron ore imported into the United States in 1927 increased 2.6 per cent in quantity and 3.3 per cent in total value as compared with 1926. The average value was $2.32 a ton in 1927 and $2.30 in 1926. Africa, Chile, and Cuba were the chief sources of imports in 1927; these three countries furnished 84 per cent of the total. The other main sources of imported ore in 1927 were Newfoundland and Labrador and Sweden; 12 per cent of the total came from these countries.

Iron ore imported into the United States, 1925–1927, by countries

Country	1925		1926		1927	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Africa:						
British West	----------	----------	----------	----------	1,860	$23,715
French—						
Algeria and Tunisia	173,070	$512,563	320,134	$997,592	445,070	1,419,410
Morocco	----------	----------	5,540	20,000	----------	----------
Other	----------	----------	1,611	20,943	1,350	17,955
Portuguese East	3,000	19,834	----------	----------	----------	----------
Australia	140	758	----------	----------	5,000	14,381
Belgium	300	1,695	55	139	----------	----------
Brazil	600	7,157	3,708	53,447	8,905	69,261
Canada	7,829	21,547	16,984	59,831	26,079	96,392
Chile	1,113,900	3,221,605	1,364,400	1,561,303	1,369,200	1,560,764
Cuba	546,130	2,074,882	539,000	2,005,112	392,113	1,499,020
Egypt	9,950	26,632	6,550	36,555	10,420	28,141
France	6,345	15,688	8,279	64,866	----------	----------
Germany	15,915	61,076	10,640	40,888	2,274	8,369
Greece	17,375	28,046	----------	----------	----------	----------
Italy	----------	----------	20	318	7,700	10,305
Netherlands	1,770	5,743	----------	----------	538	1,881
Newfoundland and Labrador	----------	----------	119,544	455,188	61,030	240,199
Norway	----------	----------	18,313	65,167	16,608	70,720
Portugal	----------	----------	900	14,856	----------	----------
Spain	144,421	333,126	83,608	235,636	27,165	72,701
Sweden	149,238	557,309	53,605	214,917	244,458	912,341
Turkey in Europe	----------	----------	445	1,187	----------	----------
United Kingdom	714	7,568	105	4,371	947	22,728
Virgin Islands of the United States	----------	----------	2,000	24,000	----------	----------
	2,190,697	6,895,229	2,555,441	5,876,316	2,620,717	6,068,283

Iron ore imported into the United States, 1872–1927

Year	Gross tons	Year	Gross tons
1872–1880	1, 188, 267	1921	315, 768
1881–1890	7, 663, 630	1922	1, 135, 156
1891–1900	5, 869, 757	1923	2, 768, 430
1901–1910	11, 798, 568	1924	2, 047, 055
1911–1915	9, 202, 947	1925	2, 190, 697
1916	1, 325, 736	1926	2, 555, 441
1917	971, 663	1927	2, 620, 717
1918	787, 468		
1919	476, 461		54, 191, 217
1920	1, 273, 456		

Exports of iron ore from the United States in 1927 amounted to 898,793 gross tons, valued at $3,425,435, or $3.81 a ton, as compared with 868,710 tons, valued at $3,380,701, or $3.89 a ton, in 1926. These figures represent an increase in 1927 of 3.5 per cent in quantity and 1.3 per cent in total value. Of the ore exported in 1927 nearly 99 per cent went to Canada.

Iron ore exported from the United States, 1926–27, by countries

Country	1926		1927	
	Gross tons	Value	Gross tons	Value
Argentina			20	$549
Canada	868, 692	$3, 380, 261	887, 049	3, 365, 967
Norway			3	14
Trinidad and Tobago			25	425
United Kingdom			11, 696	58, 480
Venezuela	18	440		
	868, 710	3, 380, 701	898, 793	3, 425, 435

Iron ore exported from the United States, 1899–1927

Year	Gross tons	Year	Gross tons
1899–1900	92, 125	1922	602, 194
1901–1910	2, 713, 397	1923	1, 116, 932
1911–1915	4, 265, 538	1924	595, 413
1916	1, 183, 952	1925	630, 521
1917	1, 132, 313	1926	868, 710
1918	1, 256, 383	1927	898, 793
1919	996, 569		
1920	1, 145, 037		17, 937, 983
1921	440, 106		

IRON-ORE MINING IN CUBA

The iron ore shipped from Cuba to the United States in 1927 amounted to 414,847 gross tons, as compared with 578,091 tons in 1926, a decrease of 28 per cent. The shipments in 1927 were 84 per cent of hematite, including a little magnetite, from the Daiquiri and Juragua mines on the southern coast and 16 per cent of brown ore from the Mayari mines near the northern coast. In 1927 the hematite, dried at 212° F., contained 59.55 per cent of iron, whereas the brown ore, nodulized, carried 55.74 per cent. In 1926 the hematite, dried, averaged 60.13 per cent, whereas the brown ore, nodulized, averaged 55.98 per cent.

The total stock of ore, natural and nodulized, reported on hand at the end of 1927 was 782,918 gross tons, compared with 849,732 tons at the end of 1926—a decrease of 8 per cent.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The statistics of the shipments of Cuban iron ore are collected by the Bureau of Mines.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1927, in gross tons

Year	Juragua (hematite and magnetite)	Sigua (hematite)	Daiquiri (hematite and a little magnetite)	Mayari (brown ore)	Guamá (hematite)	El Cuero (hematite)	Total
1884–1890	1, 142, 519						1, 142, 519
1891–1900	[1] 2, 348, 473	20, 438	[2] 979, 992				3, 348, 903
1901–1910	2, 104, 186		[3] 4, 456, 440	307, 700	41, 241	224, 729	7, 134, 296
1911–1915	1, 567, 112		1, 837, 669	1, 855, 525		532, 194	5, 792, 500
1916	212, 013		181, 602	258, 451		60, 650	712, 716
1917	39, 784		181, 028	287, 904		44, 769	553, 485
1918	17, 128		353, 103	232, 540		40, 761	643, 532
1919			279, 700	78, 080			357, 780
1920	(4)		[4] 561, 268	321, 515			882, 783
1921	(4)		[4] 130, 359				130, 359
1922	(4)		[4] 444, 794				444, 794
1923	(4)		[4] 674, 371				674, 371
1924	(4)		[4] 283, 094	11, 461			294, 555
1925	(4)		[4] 514, 040	44, 127			558, 167
1926	(4)		[4] 528, 647	49. 444			578, 091
1927	(4)		[4] 348, 607	66, 240			414, 847
	[4] 7, 431, 215	20, 438	[4] 11,754, 714	3, 512, 987	41, 241	903, 103	23, 663, 698

[1] Of this quantity, 5,932 tons was sent to Pictou, Nova Scotia.
[2] Of this quantity, 51,537 tons was sent to ports outside of the United States.
[3] Of this quantity, 12,691 tons was sent to ports outside of the United States.
[4] Shipments of Juragua mines, 1920–1927, included with Daiquiri mines.

WORLD PRODUCTION OF IRON ORE, BY COUNTRIES

The following table shows the production of iron ore by countries for 1923 to 1927, so far as figures are obtainable. Figures for preceding years appear in earlier volumes of Mineral Resources. Complete returns for 1927 are not available, but those for 1926 and earlier years are fairly complete. Thus, the figures for 1926 indicate a total world production of about 154,000,000 metric tons, of which the United States furnished about 45 per cent. In 1925 the United States contributed about 42 per cent of the world's total, which apparently was about 151,000,000 metric tons.

Iron ore produced, 1923–1927, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923	1924	1925	1926	1927
North America:					
Canada [1] [2]	27, 904	1, 343	3, 609	(3)	(3)
Cuba [1]	685, 195	299, 283	567, 126	587, 369	421, 505
Mexico	50, 694	52, 448	127, 492	92, 982	(3)
Newfoundland [4]	733, 216	992, 972	1, 150, 169	879, 603	1, 356, 851
United States	70, 464, 533	55, 138, 411	62, 901, 620	68, 708, 349	62, 732, 045
South America:					
Brazil	[5] 350		[6] 30, 000	[6] 30, 000	[6] 30, 000
Chile [7]	679, 187	987, 969	1, 350, 834	1, 476, 355	1, 516, 440

[1] Shipments.
[2] Exclusive of iron oxide used for paint.
[3] Data not available.
[4] Shipments from Wabana mines.
[5] Exports.
[6] Approximate production.
[7] Production of Tofo mine.

Iron ore produced, 1923–1927, by countries, in metric tons—Continued

Country	1923	1924	1925	1926	1927
Europe:					
Austria	1,211,065	713,805	1,030,364	1,094,372	1,598,570
Belgium	117,090	154,970	165,650	144,980	(3)
Bulgaria	(3)	300	----------	----------	----------
Czechoslovakia	675,185	1,173,935	1,229,254	1,421,174	(3)
Finland	1,000	(3)	226	----------	(3)
France	23,349,379	29,044,149	35,597,704	39,480,400	45,670,920
Germany [8]	5,014,107	4,284,789	5,742,542	4,594,937	6,004,836
Great Britain [9]	11,049,758	11,227,951	10,305,671	4,160,101	11,386,467
Greece	100,115	102,221	88,216	126,624	162,220
Hungary	138,123	101,750	68,517	131,762	194,158
Italy	340,831	218,726	495,905	504,556	503,290
Luxemburg	4,097,549	5,333,580	6,672,092	7,756,240	7,266,249
Norway	385,836	522,124	425,424	212,661	(3)
Poland	454,947	291,951	211,987	316,073	539,360
Portugal	9,115	8,573	2,000	1,640	7,600
Rumania	99,293	102,537	107,384	102,799	97,138
Russia [10]	414,423	932,969	2,201,706	3,415,278	4,816,703
Spain	3,456,233	4,612,817	4,442,872	3,181,589	4,960,394
Sweden	5,588,173	6,499,730	8,168,546	8,465,914	9,660,977
Switzerland	76,000	[5] 81,375	[5] 59,513	[5] 49,995	(3)
Yugoslavia	244,619	330,119	139,137	366,624	336,099
Asia:					
China	1,400,820	1,100,000	1,519,000	(3)	(3)
Chosen	243,279	309,443	351,444	351,575	(3)
India, British	834,231	1,468,510	1,569,368	1,685,927	(3)
Japan	55,000	57,906	75,957	81,000	(3)
Russia [10]	----------	11,626	22,752	15,154	(3)
Unfederated Malay States: Johore	156,635	238,892	276,358	254,100	416,548
Africa:					
Algeria	1,452,563	1,662,506	1,780,842	1,629,425	2,004,189
Belgian Congo	105,756	105,195	87,258	113,511	78,000
Madagascar	31	(3)	6	1	(3)
Morocco, Spanish	397,000	(3)	800,000	(3)	(3)
Rhodesia, Southern	----------	----------	1,063	1,923	477
Southwest African Protectorate	(3)	5,835	14,161	17,869	21,753
Tunisia	845,000	797,680	724,000	582,000	915,000
Union of South Africa [1]	521	----------	----------	47,200	77,523
Oceania:					
Australia—					
New South Wales [2]	178,549	142,852	157,735	159,788	182,999
Queensland	203	----------	351	4,483	507
South Australia	390,604	589,622	596,068	593,114	734,020
New Zealand	(3)	2,550	2,620	8,122	(3)

[1] Shipments. [2] Exclusive of iron oxide used for paint. [3] Data not available. [5] Exports.

[8] Exclusive of manganiferous iron ore carrying 12 to 30 per cent of manganese.

[9] Exclusive of bog ore, which is used mainly for the purification of gas.

[10] Year ended Sept. 30.

BENEFICIATED IRON ORE

In 1927 the processes reported in use in the United States to improve the quality of the ore at the mines were crushing and screening, drying, hand picking, washing, jigging, electromagnetic separation, sintering, nodulizing, and desulphurization by sintering. Some operators combined two or more of these processes. Beneficiation of iron ore was reported at 58 mines in 11 States in 1927 and at 63 mines in 11 States in 1926. Some iron ore is also recovered in the form of dust from blast furnaces, but no statistics on it have been gathered. Ore so recovered, however, has been originally included in the statistics of shipments from the mines.

Beneficiated ore shipped from mines in the United States in 1927 decreased 3 per cent in quantity but increased 1 per cent in total value as compared with 1926. Such figures as are available for 1927 to show the relation between crude ore treated and beneficiated ore recovered indicate that in washing brown ore the ratios, by weight, of crude ore washed to resultant concentrates range from 4:1 to 3:1, in concentrating hematite from 3:1 to 1.068:1, in concentrating magnetite from 2.602:1 to 1.036:1, and in concentrating carbonate 1.333:1.

The quantity of crude ore beneficiated in the Lake Superior district in 1927 amounted to 8,045,457 gross tons, and the beneficiated ore recovered was 4,927,995 tons—a loss of 3,117,462 tons and a ratio of 1.633:1. In 1926 the crude Lake ore treated amounted to 8,626,995 tons, and the beneficiated ore recovered therefrom was 5,489,286 tons—a loss of 3,137,709 tons and a ratio of 1.572:1.

Beneficiated iron ore shipped from mines in the United States, 1926–27

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	Variety	1926		1927	
		Gross tons	Value	Gross tons	Value
Alabama	Brown ore	633, 692	$1, 738, 696	607, 681	$1, 567, 178
Georgia	do	51, 642	149, 198	49, 010	143, 161
Minnesota	Hematite	5, 439, 499	13, 223, 658	4, 952, 537	12, 214, 099
Missouri	Hematite, brown ore	79, 371	(1)	47, 605	(1)
New Jersey	Magnetite	208, 329	(1)	201, 382	852, 366
New Mexico	do	216, 269	(1)	214, 747	(1)
New York	do	659, 741	3, 015, 586	936, 850	4, 568, 224
Pennsylvania	do	808, 062	3, 267, 827	843, 363	3, 433, 941
Tennessee	Hematite, brown ore	116, 175	272, 846	106, 637	251, 904
Virginia	do	49, 703	162, 446	66, 874	172, 643
Wisconsin	Hematite	109, 346	(1)	87, 987	(1)
Undistributed			2, 102, 577		970, 945
		8, 371, 829	23, 932, 834	8, 114, 673	24, 174, 461

[1] Included under "Undistributed."

The next table gives the shipments of beneficiated iron ore beginning with 1914, the first year for which statistics were gathered, and the percentage of beneficiated ore to the total ore shipped. Except for a few years the increase in the proportion of beneficiated ore has been slow but steady. During the five-year period 1914 to 1918 the shipments of beneficiated ore averaged 10.6 per cent of the total ore and increased to 13.5 per cent during the next five-year period (1919 to 1923); in 1924 and 1925 there was a fractional increase each year over the average for 1919 to 1923; in 1926 the shipments of beneficiated ore were only 12.1 per cent of the total ore shipped, but in 1927 they increased to 13.3 per cent. Minnesota has contributed more than 64 per cent of the total shipments of beneficiated ore during the period 1914 to 1927. During the five-year period 1914 to 1918 an average of 10.2 per cent of the total shipments from Minnesota was beneficiated ore; during the five-year period 1919 to 1923 the proportion was 14.9 per cent; in 1924 and 1925 it rose to 16.5 and 16.9 per cent, respectively; in 1926 it declined to 13.3 per cent, but in 1927 it rose to 13.9 per cent.

Iron ore shipped from mines in the United States, 1914–1927, in gross tons, and percentage of beneficiated ore to the total shipped

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

Year	Beneficiated	Total	Percentage of beneficiated to total	Year	Beneficiated	Total	Percentage of beneficiated to total
1914	4, 130, 298	39, 714, 280	10. 4	1921	3, 727, 621	26, 652, 528	14. 0
1915	5, 581, 029	55, 493, 100	10. 1	1922	6, 623, 144	50, 612, 620	13. 1
1916	8, 105, 011	77, 870, 553	10. 4	1923	10, 686, 992	69, 811, 472	15. 3
1917	8, 166, 564	75, 573, 207	10. 8	1924	7, 092, 539	52, 083, 375	13. 6
1918	7, 881, 570	72, 021, 202	10. 9	1925	8, 735, 672	63, 924, 763	13. 7
1919	7, 355, 934	56, 372, 784	13. 0	1926	8, 371, 829	69, 292, 832	12. 1
1920	8, 514, 838	69, 281, 341	12. 3	1927	8, 114, 673	61, 232, 473	13. 3

IRON AND STEEL

The records of the production and sales of iron and steel shown in the following pages are derived in part from data supplied by producers who report direct to the Bureau of Mines and in part from several other authoritative sources, such as the American Iron and Steel Institute, Metal Statistics, the Iron Age, and the Iron Trade Review. The statistics on imports and exports are from the Bureau of Foreign and Domestic Commerce.

PIG IRON

SHIPMENTS, VALUE, AND PRODUCTION, BY STATES

The shipments of pig iron, exclusive of ferro-alloys, reported by the manufacturers to the Bureau of Mines, represent a decrease of 9 per cent in quantity and 14 per cent in total value in 1927 as compared with 1926. The values given represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items that are figured in some of the market prices of pig iron as published in trade journals.

The pig iron shipped includes metal produced from foreign as well as from domestic ore. Although the pig iron made from ore imported from Africa, Brazil, Canada, Chile, Cuba, France, Newfoundland, Spain, and Sweden constitutes a very small percentage of the total production, it amounted in 1927 to 1,414,594 gross tons, valued at $27,161,285, as compared with 1,423,035 tons, valued at $29,020,535, from foreign ore in 1926. In the manufacture during 1927 of 1,521,130 gross tons of pig iron, 2,540,558 gross tons of foreign iron ore and 672 tons of cinder derived from foreign pyrite were reported to have been used, indicating an average pig-iron yield of 59.86 per cent from imported materials. Domestic ore and 5,601,334 gross tons of cinder, scale, and scrap, amounting in all to 67,319,717 tons, were reported used in making 34,353,999 tons of pig iron, indicating an average pig-iron yield of 51.03 per cent from domestic materials. The total production of pig iron, exclusive of ferro-alloys, reported to the Bureau of Mines, was 35,875,129 gross tons, compared with 38,755,698 tons in 1926, a decrease of 7 per cent.

Pig iron shipped from blast furnaces in the United States, 1926–27, by States

State	1926		1927	
	Gross tons	Value	Gross tons	Value
Alabama	2, 875, 534	$58, 119, 260	2, 705, 240	$50, 193, 057
Colorado	(1)	(1)	(1)	(1)
Illinois	3, 626, 330	73, 460, 392	3, 466, 203	66, 442, 068
Indiana	3, 670, 478	69, 292, 329	3, 447, 764	62, 097, 518
Kentucky	148, 053	(1)	184, 851	(1)
Maryland	791, 637	(1)	845, 564	(1)
Massachusetts	23, 130	(1)	129, 039	(1)
Michigan	638, 282	13, 180, 113	626, 532	12, 527, 993
Minnesota	292, 658	(1)	287, 813	(1)
New Jersey	(1)	(1)	------------	------------
New York	2, 389, 665	44, 970, 196	2, 401, 432	40, 803, 579
Ohio	9, 177, 127	176, 433, 401	8, 184, 066	150, 125, 790
Pennsylvania	13, 142, 528	263, 238, 184	11, 145, 334	212, 179, 275
Tennessee	113, 029	2, 544, 825	87, 971	1, 911, 380
Utah	(1)	(1)	(1)	(1)
Virginia	105, 019	2, 322, 451	84, 920	1, 782, 538
West Virginia	364, 302	(1)	504, 816	(1)
Wisconsin	235, 597	5, 034, 012	(1)	(1)
Undistributed	[2] 587, 684	[2] 41, 038, 305	[2] 765, 099	[2] 48, 162, 941
	38, 181, 053	749, 633, 468	34, 866, 644	646, 226, 139

[1] Included under "Undistributed."

[2] Includes figures for States entered as "(1)" above.

Pig iron shipped from blast furnaces in the United States, 1926–27, by grades

Grade	1926			1927		
	Gross tons	Value		Gross tons	Value	
		Total	Average		Total	Average
Charcoal	157,232	$4,187,292	$26.63	140,728	$3,482,097	$24.74
Foundry	5,099,697	100,934,853	19.79	4,889,889	91,015,404	18.61
Basic	21,345,155	407,801,968	19.11	19,295,759	346,842,546	17.98
Bessemer	9,355,671	191,896,308	20.51	8,292,184	161,106,090	19.43
Low-phosphorus	283,898	6,679,787	23.53	303,027	7,030,622	23.20
Malleable	1,619,990	31,238,844	19.28	1,606,153	29,895,697	18.61
Forge	191,274	3,965,143	20.73	147,016	2,840,605	19.32
All other (not ferro-alloys)	128,136	2,929,273	22.86	191,888	4,013,078	20.91
	38,181,053	749,633,468	19.63	34,866,644	646,226,139	18.53

Pig iron shipped from blast furnaces in the United States, 1910–1927

Year	Gross tons	Value	Year	Gross tons	Value
1910	26,674,123	$412,162,486	1919	30,130,231	$775,915,043
1911	23,257,288	327,334,624	1920	35,710,227	1,140,904,096
1912	30,180,969	420,563,388	1921	16,038,619	389,437,792
1913	30,388,935	458,342,345	1922	27,670,738	608,144,858
1914	22,263,263	298,777,429	1923	38,361,379	946,799,378
1915	30,384,486	401,409,604	1924	31,064,129	665,078,972
1916	39,126,324	663,478,118	1925	36,814,702	739,316,333
1917	38,612,546	1,053,785,975	1926	38,181,053	749,633,468
1918	38,230,440	1,180,759,565	1927	34,866,644	646,226,139

The American Iron and Steel Institute reports that in 1927 the output of all kinds of pig iron and ferro-alloys decreased 2,807,084 gross tons, or 7 per cent, as compared with 1926.

Pig iron, including ferro-alloys, manufactured in the United States, 1926–27, in gross tons [1]

State	1926	1927	State	1926	1927
Pennsylvania	13,587,881	11,829,599	West Virginia Kentucky	516,094	699,514
Ohio	9,359,275	8,502,459	Iowa Colorado Utah	633,864	641,057
Illinois	3,659,974	3,588,595	Maryland	805,373	855,566
Alabama	2,953,294	2,782,993	Tennessee	110,146	133,785
Indiana Michigan	4,377,068	4,201,802	Virginia	103,000	99,197
New York New Jersey Massachusetts	2,729,261	2,775,351		39,372,729	36,565,645
Wisconsin Minnesota	537,499	455,727			

[1] American Iron and Steel Institute.

AVERAGE VALUES

Values at blast furnaces.—The average value of all kinds of pig iron given in the accompanying table is based on the reports of the manufacturers to the Bureau of Mines. The figures represent the approximate values f. o. b. at the blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces, exclusive of ferro-alloys, decreased nearly 6 per cent in 1927 and was the lowest for any year since 1916.

Average value per gross ton of pig iron at blast furnaces in the United States, 1922–1927

State	1922	1923	1924	1925	1926	1927
Alabama	$19.29	$19.72	$20.92	$19.85	$20.21	$18.55
Illinois	21.60	25.36	22.00	20.81	20.26	19.17
Indiana	19.65	23.26	20.42	19.34	18.88	18.01
Kentucky	21.05	(1)	(1)	(1)	(1)	(1)
Michigan	24.83	26.25	23.41	22.19	20.65	20.00
New York	22.11	23.71	19.93	18.80	18.82	16.99
Ohio	22.17	24.76	21.48	19.58	19.23	18.34
Pennsylvania	22.77	25.02	21.62	20.59	20.03	19.04
Tennessee	21.65	26.95	21.97	21.16	22.51	21.73
Virginia	25.59	26.76	24.01	22.86	22.11	20.99
West Virginia	24.32	24.68	21.77	18.87	(1)	(1)
Wisconsin	23.75	25.90	22.88	21.34	21.37	(1)
Other States [2]	22.11	24.73	21.57	19.83	18.59	17.73
Average for United States	21.98	24.68	21.41	20.08	19.63	18.53

[1] Included under "Other States."

[2] 1922: Colorado, Connecticut, Maryland, Massachusetts, Minnesota, Missouri, and New Jersey; 1923: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, Missouri, and New Jersey; 1924: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, and Utah; 1925: Colorado, Kentucky, Maryland, Minnesota, Missouri, New Jersey, and Utah; 1926: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, New Jersey, Utah, and West Virginia; 1927: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, Utah, West Virginia, and Wisconsin.

Average value per gross ton of pig iron at blast furnaces in the United States 1889–1927

Year	Value	Year	Value
1889	$15.78	1909	$16.25
1890	16.43	1910	15.45
1891	15.50	1911	14.07
1892	14.32	1912	13.93
1893	11.90	1913	15.08
1894	9.76	1914	13.42
1895	11.14	1915	13.21
1896	10.47	1916	16.96
1897	9.85	1917	27.29
1898	9.90	1918	30.89
1899	18.00	1919	25.75
1900	18.85	1920	31.95
1901	15.25	1921	24.28
1902	20.92	1922	21.98
1903	19.12	1923	24.68
1904	14.13	1924	21.41
1905	16.63	1925	20.08
1906	19.98	1926	19.63
1907	20.56	1927	18.53
1908	15.96		

Commercial quotations.—The average monthly prices, according to published market quotations, of the chief grades of pig iron at the blast furnaces or at the nearest market during 1926 and 1927 are summarized in the following table for comparison with preceding tables giving the figures reported by blast-furnace operators. The average commercial quotations for each of the four grades of iron show a decrease and are lower than the average values reported by manufacturers, but the reader should remember that the manufacturers' values represent weighted averages of what was actually received for the metal, and a discrepancy between the two sets of figures is to be expected.

Average monthly prices per ton of chief grades of pig iron, 1926–27 [1]

Month	Foundry pig iron at Valley furnaces		Foundry pig iron at Birmingham furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1926	1927	1926	1927	1926	1927	1926	1927
January	$20.50	$18.50	$22.00	$18.56	$21.00	$19.50	$20.00	$18.16
February	20.50	18.50	21.79	18.00	21.00	19.02	20.00	18.00
March	20.50	18.50	21.78	18.00	21.00	19.37	20.00	18.28
April	19.29	18.50	22.00	18.00	19.90	19.50	18.90	19.00
May	19.00	18.50	22.00	18.00	19.50	19.24	18.50	18.24
June	18.04	18.35	21.83	18.00	19.02	18.96	18.02	17.96
July	17.73	18.00	20.50	17.64	18.81	18.50	17.52	17.50
August	17.50	17.65	20.50	17.12	18.40	18.50	17.50	17.32
September	17.54	17.50	20.44	17.25	18.16	18.00	17.50	17.11
October	18.21	17.50	20.00	17.20	19.12	18.00	17.71	17.00
November	19.00	17.47	20.00	16.00	19.76	18.00	18.50	17.00
December	18.77	17.25	20.00	16.00	19.96	17.69	18.50	17.00
Average	18.88	18.02	21.07	17.48	19.64	18.69	18.55	17.71

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[1] Metal Statistics, 1928.

PRODUCTION BY GRADES AND BY FUEL USED, TOTAL PRODUCTION, AND BLAST FURNACES

The statistics of production of pig iron by grades and by fuel used for 1923 to 1927, the total output of pig iron, and the number of furnaces in blast in 1926 and 1927 have been published by the American Iron and Steel Institute, as shown in the tables that follow. These figures include ferro-alloys. Metals produced by the use of electricity and by the use of coke and electricity together are included in coke pig iron.

Pig iron, including ferro-alloys, manufactured in the United States, 1923–1927, by grades, in gross tons

Grade	1923	1924	1925	1926	1927
Bessemer and low-phosphorus	11,677,509	8,172,297	9,419,461	10,042,324	9,105,915
Basic	19,795,590	15,999,012	19,667,380	21,168,407	19,357,064
Forge	327,430	255,961	240,652	216,277	144,532
Foundry and ferrosilicon	6,470,013	5,623,124	5,410,217	5,752,573	5,782,696
Malleable	1,571,064	973,158	1,553,636	1,681,897	1,699,583
Spiegeleisen	129,686	107,066	65,755	76,215	100,720
Ferromanganese	247,031	194,243	260,029	318,891	293,626
White, mottled, direct castings, etc	142,823	80,929	83,436	116,145	81,509
	40,361,146	31,405,790	36,700,566	39,372,729	36,565,645

Pig iron, including ferro-alloys, manufactured in the United States, 1923–1927, by fuel used, in gross tons

Fuel used	1923	1924	1925	1926	1927
Bituminous, chiefly coke	40,097,239	31,193,080	36,504,402	39,208,849	36,398,791
Anthracite and coke	12,730	--------	--------	--------	--------
Charcoal	251,177	212,710	196,164	163,880	166,854
	40,361,146	31,405,790	36,700,566	39,372,729	36,565,645

The next table shows the production in the United States of pig iron, including ferro-alloys, so far as it has been recorded. Statistics by years prior to 1916 will be found in Mineral Resources for 1918 and earlier years.

Pig iron, including ferro-alloys, manufactured in the United States, 1810–1927

Year	Gross tons	Year	Gross tons
1810–1860	10, 542, 548	1920	36, 925, 987
1861–1870	11, 366, 963	1921	16, 688, 126
1871–1880	24, 055, 278	1922	27, 219, 904
1881–1890	56, 902, 041	1923	40, 361, 146
1891–1900	98, 124, 754	1924	31, 405, 790
1901–1910	211, 321, 934	1925	36, 700, 566
1911–1915	137, 591, 093	1926	39, 372, 729
1916	39, 434, 797	1927	36, 565, 645
1917	38, 621, 216		
1918	39, 054, 644		963, 270, 525
1919	31, 015, 364		

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1926 and 1927, exclusive of electric reduction furnaces, were as follows:

Blast furnaces in the United States, 1926 and 1927

State	In blast June 30, 1926	Dec. 31, 1926			In blast June 30, 1927	Dec. 31, 1927		
		In	Out	Total		In	Out	Total
Alabama	24	21	14	35	18	18	16	34
Colorado	2	3	2	5	3	3	2	5
Illinois	17	15	11	26	17	16	10	26
Indiana	17	13	5	18	15	11	7	18
Kentucky	1	1	3	4	2	1	4	5
Maryland	5	5	1	6	5	5	1	6
Massachusetts	--------	1	--------	1	1	1	--------	1
Michigan	9	10	1	11	10	10	1	11
Minnesota	2	2	1	3	2	2	1	3
Mississippi	--------	--------	1	1	--------	--------	1	1
Missouri	--------	--------	3	3	--------	--------	2	2
New Jersey	--------	--------	3	3	--------	--------	2	2
New York	15	16	10	26	15	13	11	24
Ohio	50	44	25	69	42	35	29	64
Pennsylvania	74	70	54	124	54	48	55	103
Tennessee	1	2	12	14	3	2	10	12
Texas	--------	--------	1	1	--------	--------	1	1
Utah	1	1	--------	1	1	--------	1	1
Virginia	2	2	15	17	1	1	13	14
West Virginia	2	3	2	5	3	2	3	5
Wisconsin	2	1	5	6	1	1	4	5
	224	210	169	379	193	169	174	343

FOREIGN TRADE IN PIG IRON

Imports of pig iron into the United States during 1927 decreased 70 per cent in quantity and 71 per cent in total value, as compared with 1926. India was the chief source of imported pig iron in 1927, supplying 50 per cent of the total. Germany, the chief source in 1926, furnished only 7 per cent of the total in 1927.

Pig iron imported into the United States, 1923–1927, by countries, in gross tons

Country	1923	1924	1925	1926	1927
North America:					
Canada	54,076	15,933	6,455	4,767	725
Dominican Republic	----------	----------	3	----------	----------
Honduras	----------	200	----------	----------	----------
Mexico	1	----------	----------	70	97
Europe:					
Austria	299	----------	----------	----------	----------
Belgium	14,980	3,019	11,068	7,488	699
France	57,722	23,208	9,814	28,449	3,000
Germany	20,740	11,228	75,052	157,094	9,211
Ireland	----------	50	----------	----------	----------
Netherlands	----------	23,857	54,904	69,054	29,380
Norway	----------	----------	----------	2	----------
Sweden	705	700	2,169	3,455	1,700
United Kingdom—					
England	179,937	52,593	96,869	92,083	21,129
Scotland	18,201	4,546			
Asia:					
China	3,129	2,375	200	----------	----------
India, British	17,988	71,370	184,325	83,311	66,627
Japan	----------	----------	(1)	----------	----------
Kwantung	----------	30	566	----------	----------
	367,778	209,109	441,425	445,773	132,568
Value	$9,005,077	$3,741,213	$7,951,283	$7,708,982	$2,254,355

[1] Less than 1 ton.

Pig iron [1] imported into the United States, 1918–1927

Year	Gross tons	Value	Year	Gross tons	Value
1918 [1]	34,711	$4,968,056	1923	367,778	$9,005,077
1919 [1]	101,665	6,565,106	1924	209,109	3,741,213
1920 [1]	185,944	12,801,834	1925	441,425	7,951,283
1921 [1]	44,036	2,014,926	1926	445,773	7,708,982
1922	383,445	8,670,860	1927	132,568	2,254,355

[1] Figures for 1918 to 1921, inclusive, include ferro-alloys. Separate data not available prior to 1922.

Exports of pig iron from the United States increased 102 per cent in quantity and 96 per cent in total value in 1927, as compared with 1926. Canada was the best customer in 1927, taking 69 per cent of the total exports. The average value was $20.17 a ton in 1927, as compared with $20.78 a ton in 1926.

Pig iron exported from the United States, 1926–27, by countries, in gross tons

Country	1926	1927	Country	1926	1927
North America:			Europe—Continued.		
Canada	18,217	35,128	France	15	----------
Cuba	818	763	Germany	185	275
Mexico	204	131	Italy	26	96
Panama	422	450	United Kingdom	3,761	6,910
Other countries	69	73	Other countries	23	90
South America:			Asia:		
Chile	469	908	China	10	1
Colombia	146	271	Japan, including Chosen	51	4,398
Peru	478	500	Philippine Islands	50	455
Other countries	11	37			
Europe:				25,208	50,992
Belgium	253	506	Value	$523,883	$1,028,425

Pig iron [1] *exported from the United States, 1918–1927*

Year	Gross tons	Value	Year	Gross tons	Value
1918 [1]	269, 575	$11, 576, 721	1923	32, 318	$862, 443
1919 [1]	321, 261	12, 313, 183	1924	41, 483	957, 921
1920 [1]	216, 828	10, 074, 377	1925	32, 674	724, 565
1921 [1]	28, 307	933, 093	1926	25, 208	523, 883
1922	30, 920	756, 842	1927	50, 992	1, 028, 425

[1] Figures for 1918 to 1921, inclusive, include ferro-alloys. Separate data not available prior to 1922.

WORLD PRODUCTION OF PIG IRON, BY COUNTRIES

The accompanying table shows the predominance of the United States in the manufacture of pig iron, and with the table giving exports from the United States indicates that the consumption in the principal European countries is still comparatively small.

Pig iron (including ferro-alloys) produced, 1923–1927, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923	1924	1925	1926	1927
Australia	335, 096	422, 728	446, 472	445, 739	518, 000
Austria	341, 875	266, 463	379, 921	331, 635	432, 749
Belgium	2, 147, 950	2, 843, 920	2, 542, 507	3, 368, 347	3, 751, 440
Brazil [1]	70, 000	70, 000	70, 000	70, 000	70, 000
Canada	923, 362	629, 386	605, 674	827, 809	778, 509
China	520, 000	480, 000	369, 617	400, 000	300, 000
Chosen	99, 933	99, 795	101, 933	118, 102	(2)
Czechoslovakia	817, 050	983, 042	1, 166, 422	1, 087, 984	1, 300, 000
Finland	9, 257	10, 653	11, 352	8, 871	(2)
France	5, 467, 872	7, 692, 565	8, 505, 122	9, 392, 917	9, 293, 000
Germany (exclusive of the Saar)	4, 940, 505	7, 832, 554	10, 088, 751	9, 636, 054	13, 102, 528
Saar	1, 021, 000	1, 389, 117	1, 453, 056	1, 638, 051	1, 780, 000
Great Britain	7, 559, 920	7, 436, 368	6, 362, 200	2, 497, 654	7, 409, 951
Hungary	124, 445	115, 502	93, 130	187, 813	299, 332
India, British	655, 221	923, 125	906, 838	936, 932	900, 000
Italy	269, 166	341, 317	536, 245	558, 509	529, 433
Japan	599, 698	585, 930	685, 178	809, 624	700, 000
Luxemburg	1, 406, 666	2, 157, 170	2, 363, 253	2, 559, 151	2, 723, 356
Mexico	21, 210	19, 485	38, 000	61, 796	(2)
New Zealand		640	1, 310	4, 061	3, 437
Norway	26, 395	64, 955	87, 931	97, 311	(2)
Philippine Islands	269	273	398	306	(2)
Poland	547, 288	335, 850	314, 564	327, 471	618, 186
Rumania	39, 102	46, 081	64, 273	62, 979	63, 498
Russia [3]	312, 076	669, 642	1, 308, 067	2, 217, 348	2, 947, 000
Spain	408, 659	510, 279	530, 029	488, 696	593, 070
Sweden	301, 619	535, 361	462, 559	500, 687	500, 000
Union of South Africa				20, 382	(2)
United States	41, 008, 942	31, 909, 853	37, 289, 610	40, 004, 661	37, 152, 524
Yugoslavia	26, 361	15, 019	3, 494	18, 768	22, 651

[1] Official estimate of annual production.

[2] Data not available.

[3] Year ended Sept 30.

FERRO-ALLOYS

PRODUCTION, SHIPMENTS, VALUE, AND PRICES

In these reports the statistics on the output of ferro-alloys in the United States are separated from those of pig iron in order that the values given may be more nearly accurate. Although the quantity of ferro-alloys is relatively small the values per ton are so high that failure to separate the figures would unduly increase the apparent average value of the pig iron.

The shipments of ferro-alloys of all classes in 1927 decreased 6 per cent in quantity and 10 per cent in total value as compared with 1926. The production of ferro-alloys in 1926 was 674,389 gross tons; in 1927 it was 709,649 tons, an increase of 5 per cent. Ferro-alloys were made in 1927 at 13 blast furnaces, 15 electric furnaces, and 2 alumino-thermic plants; in addition, 2 plants made ferrosilicon and 1 plant made ferrophosphorus as a by-product.

Ferro-alloys shipped from furnaces in the United States, 1926–27, by varieties

Variety of alloy	1926		1927	
	Gross tons	Value	Gross tons	Value
Ferromanganese	330,070	$31,711,871	291,056	$27,243,489
Silicomanganese and silicospiegeleisen	2,183	354,364	3,173	301,321
Spiegeleisen	82,982	2,016,088	80,892	1,986,188
Ferrosilicon (7 per cent or more silicon)	233,428	12,119,465	232,576	11,903,782
Ferromolybdenum and calcium-molybdenum compounds	1,096	1,051,881	(1)	(1)
Ferrotungsten	1,771	2,900,053	1,289	2,185,788
Ferrovanadium	1,777	4,721,903	1,467	3,939,067
Other varieties [2]	35,951	6,492,782	36,296	7,603,939
	689,258	61,368,407	646,749	55,163,574

[1] Included under "Other varieties."

[2] 1926: Ferrochromium, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon; 1927: Ferrochromium, ferromolybdenum and calcium-molybdenum compounds, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon.

Ferro-alloys shipped from furnaces in the United States, 1918–1927, in gross tons[1]

Year	Ferro-manganese	Spiegel-eisen	Other varieties	Total	
				Quantity	Value
1918 [1]	306,076	263,861	180,931	750,868	$115,433,943
1919	198,255	90,855	130,528	419,638	53,730,964
1920	276,594	103,672	232,542	612,808	77,519,367
1921	111,374	69,230	68,023	248,627	21,697,785
1922	161,612	70,253	191,415	423,280	28,259,004
1923	226,365	134,086	219,366	579,817	49,877,231
1924	232,821	76,179	188,244	497,244	43,249,948
1925	254,005	95,890	266,327	616,222	53,048,100
1926	330,070	82,982	276,206	689,258	61,368,407
1927	291,056	80,892	274,801	646,749	55,163,574

[1] The figures for 1918 fall short of the actual production of the United States, as the output of certain electrically produced ferro-alloys is not available for publication.

The following records of average contract prices of ferromanganese and of spiegeleisen, by months, for the last four years, show a wide range. The ferromanganese prices are quoted for material "delivered at Pittsburgh"; those for spiegeleisen are prices at producers' furnaces.

Quoted prices per ton of ferromanganese and spiegeleisen, 1924–1927 [1]

Month	Ferromanganese (delivered at Pittsburgh)				Spiegeleisen (at producers' furnaces)			
	1924	1925	1926	1927	1924	1925	1926	1927
January	$113.79	$116.79	$119.79	$104.79	$39.00	$32.00	$34.00	$37.00
February	112.29	119.79	119.79	104.79	39.00	33.00	34.00	37.00
March	112.29	119.79	102.29	104.79	38.00	33.00	34.00	37.00
April	112.29	119.79	92.79	104.79	36.00	33.00	34.00	37.00
May	112.29	119.79	92.79	98.55	36.75	33.00	34.00	35.50
June	112.29	119.79	92.79	94.79	36.00	32.00	34.00	34.80
July	110.79	119.79	92.79	94.79	35.00	31.50	34.00	34.00
August	98.79	119.79	92.79	94.79	32.50	32.25	34.00	33.35
September	97.79	119.79	92.79	94.79	32.00	33.00	34.00	33.00
October	104.79	119.79	99.79	94.79	31.00	33.00	34.00	30.15
November	107.29	119.79	104.79	94.79	31.75	34.00	38.75	30.00
December	109.79	119.79	104.79	104.79	31.00	34.00	37.00	31.00

[1] Iron Trade Review.

Ferromanganese.—The shipments of ferromanganese in 1927 amounted to 291,056 gross tons, a decrease of 12 per cent from 1926. The average value per ton f. o. b. furnaces reported for ferromanganese was $93.60 in 1927, compared with $96.08 in 1926. Ferromanganese was made at 7 furnaces by 3 producers in 1927 and at 8 furnaces by 3 producers in 1926.

The production of ferromanganese in 1927 was 294,991 gross tons, containing about 232,900 tons of manganese (metal), an average of 78.95 per cent of manganese. In the production of ferromanganese in 1927 there were used 564,725 gross tons of foreign manganese ore, 25,298 tons of domestic manganese ore, 12,735 tons of iron ore and manganiferous iron ore, and 8,570 tons of cinder, scale, and scrap. The quantity of manganese ore used per ton of ferromanganese made in 1927 was 2 tons; in 1926 it was 2.063 tons; and in 1925 it was 2.133 tons. Of the foreign manganese ore used in 1927 Brazil supplied 245,485 gross tons; Russia, 184,402 tons; India, 78,548 tons; and Africa, 41,470 tons; the remainder was from Cuba, Chile, and Porto Rico. The quantity of domestic manganese ore used in the manufacture of ferromanganese in 1927 represented only 4.3 per cent of the total manganese ore used.

Manganese ore and other metallic materials consumed and ferromanganese produced in the United States, 1921–1927

Year	Materials consumed (gross tons)				Ferromanganese produced			Manganese ore used per ton of ferromanganese made (gross tons)
	Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and scrap	Gross tons	Manganese contained		
	Foreign	Domestic				Per cent	Gross tons	
1921	208,376	17,839	143	2,092	104,129	76.17	79,319	2.172
1922	335,165	1,804	----------	5,252	150,010	78.55	117,836	2.246
1923	538,280	26,790	498	6,945	251,938	78.13	196,844	2.243
1924	443,260	20,133	909	4,434	211,965	78.21	165,776	2.186
1925	519,139	34,942	4,949	11,072	259,780	78.93	205,046	2.133
1926	619,898	36,309	8,064	5,122	318,052	79.25	252,066	2.063
1927	564,725	25,298	12,735	8,570	294,991	78.95	232,900	2.000

Manganese ore used in the manufacture of ferromanganese in the United States, 1926–27, by sources of ore, in gross tons

Source of ore	1926	1927
Africa	42,692	41,470
Brazil	237,358	245,485
Chile	5,653	3,746
Cuba	18,372	9,408
India	31,667	78,548
Porto Rico	1,202	1,666
Russia	282,954	184,402
	619,898	564,725
United States	36,309	25,298
	656,207	590,023

Spiegeleisen.—The shipments of spiegeleisen in 1927, amounting to 80,892 gross tons, were 2.5 per cent less than in 1926. The average value per ton at the furnaces in 1927 was $24.55; in 1926 it was $24.30. Spiegeleisen was made at 5 furnaces by 3 producers in 1927 and at 2 furnaces by 2 producers in 1926.

The production of spiegeleisen in 1927 was 100,314 gross tons, containing about 20,400 tons of manganese (metal), an average of about 20.34 per cent. In the production of spiegeleisen in 1927 there were used 1,640 tons of manganese ore, 5,536 tons of manganiferous iron ore, 172,396 tons of miscellaneous manganese-bearing materials, and 13,010 tons of iron-bearing materials. The quantity of these materials used per ton of spiegeleisen made in 1927 was 1.92 tons; in 1926 it was 2.019 tons; and in 1925 it was 1.87 tons.

Ferrosilicon.—The ferrosilicon produced in 1927 amounted to 267,022 gross tons, compared with 234,453 tons in 1926, an increase of 14 per cent. Of the ferrosilicon produced in 1927, a little less than 43 per cent was made by the blast-furnace process, nearly 57 per cent by the electric furnace process, and a little as a by-product of electric furnaces in the manufacture of artificial abrasives. The shipments of ferrosilicon in 1927, amounting to 232,576 gross tons, were slightly less than in 1926.

Ferrotungsten.—The production of ferrotungsten in 1927 was 1,278 gross tons, containing 2,226,174 pounds of tungsten (metal), an average of 77.74 per cent of tungsten. Ferrotungsten was made at 4 furnaces by 4 producers in 1927 and at 5 furnaces by 5 producers in 1926. The greater part of the ferrotungsten produced in 1927 was made from foreign ores, chiefly from China and Burma. The domestic ores used came mostly from California, Colorado, and Nevada, but a little ore from Arizona, Montana, and South Dakota was also used.

The shipments of ferrotungsten in 1927, amounting to 1,289 gross tons, contained 2,233,702 pounds of tungsten, and the average value per pound of contained tungsten was 98 cents f. o. b. furnaces, compared with 95 cents in 1926.

Ferrovanadium.—The ferrovanadium produced in 1927 amounted to 1,543 gross tons, containing 1,297,623 pounds of vanadium (metal), an average of 37.53 per cent of vanadium. Ferrovanadium was made at 5 furnaces by 5 producers in both 1927 and 1926. Although the ferrovanadium produced in 1927 was made chiefly from foreign ores—patronite and its oxidation products from Peru, vanadinite and descloizite from Northern Rhodesia and British Southwest Africa, and some vanadinite from Mexico—vanadium pentoxide made from carnotite and roscoelite mined in Arizona, Colorado, and Utah entered in appreciable amount into the output of ferrovanadium.

The shipments of ferrovanadium in 1927 were 1,467 gross tons, which contained 1,236,568 pounds of vanadium and were valued at the furnaces at an average of $3.19 per pound of contained vanadium, as compared with $3.28 in 1926.

IMPORTS AND EXPORTS

The imports of the alloys of the rarer metals are not all reported separately but are grouped as shown in the next table. Ferromanganese constituted the bulk of the imports; 79 per cent of it came from Canada and the United Kingdom in 1927. Norway contributed only 20 per cent of the total imports of ferromanganese in 1927, as compared with 42 per cent in 1926.

Prior to the tariff of September 22, 1922, the Bureau of Foreign and Domestic Commerce recorded only the gross weight of the ferro-alloys imported. Since that date the import statistics are not uniform, the gross weight of some ferro-alloys and the contained rarer metal of others being recorded. The reader should bear in mind this change when comparing the quantities in the two following tables with quantities published before the change in tariff. The values, however, are comparable.

The exports of ferro-alloys are relatively unimportant. Ferromanganese and spiegeleisen, the exports of which in 1927 were about 137 per cent greater than those in 1926, constituted the greater part of the total exports in 1927.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1926–27, by varieties

Variety of alloy	1926		1927	
	Gross tons	Value	Gross tons	Value
Ferromanganese (manganese content)	47,768	$4,410,142	36,400	$3,553,465
Spiegeleisen	8,783	256,714	7,529	220,979
Ferrochrome and chromium:				
Ferrochrome—				
Containing 3 per cent or more carbon (chromium content)	15	2,569	1	143
Containing less than 3 per cent carbon	495	120,235	143	32,096
Chrome or chromium metal	1	765	10	2,879
Chromium vanadium	20	2,811	----------	----------
Ferrosilicon (silicon content)	13,038	1,375,227	7,347	923,158
Molybdenum and ferromolybdenum (molybdenum content)	(1)	987	1	5,712
Titanium and ferrotitanium	23	9,189	8	3,310
Tungsten and ferrotungsten (tungsten content)	156	125,118	12	10,482
	----------	6,303,757	----------	4,752,224

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[1] 604 pounds.

Ferromanganese and ferrosilicon imported into the United States, 1926–27, by countries

[General imports]

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1926		1927		1926		1927	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
Canada	18,792	$2,098,701	17,923	$2,171,589	12,781	$1,354,014	6,134	$757,381
France	226	50,705	411	79,842			25	6,096
Germany	243	30,176			(1)	13		
India, British	157	11,806						
Italy	29	3,382	23	3,212				
Norway	18,596	1,353,960	6,724	537,406	342	31,855	1,589	261,760
Sweden	149	17,676	25	4,909			5	806
United Kingdom	5,740	572,062	8,912	608,037	1	164		
	43,932	4,138,468	34,018	3,404,995	13,124	1,386,046	7,753	1,026,043

[1] Less than 1 ton.

Ferro-alloys and ferro-alloy metals exported from the United States, 1925–1927, by varieties

Variety of alloy	1925		1926		1927	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Ferromanganese [1] Spiegeleisen [1]	5,496	$160,568	693	$44,111	1,641	$61,793
Tungsten and ferrotungsten (including tungsten wire)	6	143,987	13	155,653	9	164,917
Ferrovanadium	46	106,754	(1)	(1)	(1)	(1)

[1] Not separately classified.

STEEL

PRODUCTION

The following tables showing the production of steel were compiled by the American Iron and Steel Institute. No data whatever are available on the value of the output of crude steel at the mills, but the weekly issues and annual statistical reviews of the Iron Age give market quotations of prices of steel billets and some of the leading forms of finished steel. The price of Bessemer steel billets at Pittsburgh in 1927 ranged from $33 to $35 a gross ton; in 1926 it was $35 a ton throughout the year. Tank plates at Pittsburgh ranged from 1.75 to 1.9 cents a pound in 1927 and from 1.8 to 1.9 cents a pound in 1926. Structural shapes at Pittsburgh ranged from 1.75 to 1.98 cents a pound in 1927 and from 1.9 to 2 cents a pound in 1926.

Bessemer steel ingots and castings manufactured in the United States, 1923–1927, by States, in gross tons

State	1923	1924	1925	1926	1927
Ohio	3, 557, 579	2, 557, 689	2, 963, 590	3, 035, 809	2, 440, 235
Pennsylvania	3, 115, 840	2, 210, 868	2, 354, 231	2, 420, 719	2, 108, 483
Illinois	1, 057, 576	598, 442	740, 212	874, 047	835, 254
Other States	753, 093	532, 591	665, 929	603, 993	807, 755
	8, 484, 088	5, 899, 590	6, 723, 962	6, 934, 568	6, 191, 727

Open-hearth steel ingots and castings manufactured in the United States, 1923–1927, by States, in gross tons

State	1923	1924	1925	1926	1927
New England States	268, 630	252, 273	296, 091	288, 533	256, 716
New York and New Jersey	1, 951, 278	1, 424, 677	1, 724, 720	2, 086, 525	2, 003, 599
Pennsylvania	14, 428, 187	12, 243, 713	14, 021, 750	15, 622, 857	13, 708, 156
Ohio	7, 786, 820	7, 119, 786	8, 799, 951	8, 628, 247	8, 266, 708
Indiana	4, 326, 724	3, 990, 165	4, 978, 558	5, 278, 230	5, 118, 620
Illinois	2, 579, 095	2, 184, 068	2, 817, 027	2, 871, 688	2, 741, 472
Other States	4, 558, 923	4, 362, 668	5, 396, 391	5, 915, 899	5, 973, 064
	35, 899, 657	31, 577, 350	38, 034, 488	40, 691, 979	38, 068, 335

According to these tables there was a decrease of 11 per cent in the production of Bessemer steel and of 6 per cent in open-hearth steel in 1927 as compared with 1926; the total production of steel decreased 7 per cent. Of the total output in 1927, 84.7 per cent was represented by open-hearth steel, 13.8 per cent by Bessemer steel, and 1.5 per cent by all other classes of steel.

Of the total output of open-hearth steel 37,144,268 gross tons was made by the basic process and 924,067 tons by the acid process, compared with 39,653,315 tons of basic steel and 1,038,664 tons of acid steel in 1926.

The production of steel by the electric process in 1927 showed an increase of 2 per cent as compared with 1926.

Steel electrically manufactured in the United States, 1909–1927, in gross tons

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1909	13, 456	306	13, 762	1919	272, 942	111, 510	384, 452
1910	50, 821	1, 320	52, 141	1920	346, 956	155, 196	502, 152
1911	27, 227	1, 878	29, 105	1921	84, 404	85, 095	169, 499
1912	14, 147	4, 162	18, 309	1922	191, 057	154, 982	346, 039
1913	20, 973	9, 207	30, 180	1923	279, 914	235, 958	515, 872
1914	15, 458	8, 551	24, 009	1924	225, 977	206, 549	432, 526
1915	46, 348	23, 064	69, 412	1925	335, 978	279, 534	615, 512
1916	126, 048	42, 870	168, 918	1926	325, 278	326, 445	651, 723
1917	239, 632	64, 911	304, 543	1927	371, 278	294, 809	666, 087
1918	403, 068	108, 296	511, 364				

Figures for the total production of electric steel in 1927 include 343,517 tons of alloy-steel ingots and castings that were alloyed with nickel, vanadium, tungsten, chromium, molybdenum, and other metals (284,360 tons of ingots and 59,157 tons of castings), compared with 306,811 tons (242,808 tons of ingots and 64,003 tons of castings) so alloyed in 1926.

On December 31, 1927, the number of completed plants equipped for the manufacture of steel by the electric process was 222, as compared with 215 plants at the end of 1926.

Steel produced in the United States, 1810–1927, in gross tons

Year	Bessemer	Open-hearth	Crucible	Other steel	Total
1810–1870	58, 482	2, 232	146, 370		207, 084
1871	40, 179	1, 785	31, 250		73, 214
1872–1880	4, 293, 896	245, 035	349, 730	76, 009	4, 964, 670
1881–1890	21, 596, 699	2, 387, 925	703, 489	37, 044	24, 725, 157
1891–1900	49, 387, 341	15, 392, 764	762, 446	35, 820	65, 578, 371
1901–1910	94, 048, 698	92, 418, 814	1, 051, 379	154, 683	187, 673, 574
1911–1915	42, 329, 520	98, 833, 090	544, 047	185, 692	141, 892, 349
1916	11, 059, 039	31, 415, 427	129, 692	169, 522	42, 773, 680
1917	10, 479, 960	34, 148, 893	126, 716	305, 038	45, 060, 607
1918	9, 376, 236	34, 459, 391	115, 112	511, 693	44, 462, 432
1919	7, 271, 562	26, 948, 694	63, 572	387, 404	34, 671, 232
1920	8, 883, 087	32, 671, 895	72, 265	505, 687	42, 132, 934
1921	4, 015, 938	15, 589, 802	7, 613	170, 444	19, 783, 797
1922	5, 919, 298	29, 308, 983	28, 606	346, 039	35, 602, 926
1923	8, 484, 088	35, 899, 657	44, 079	515, 872	44, 943, 696
1924	5, 899, 590	31, 577, 350	22, 473	432, 526	37, 931, 939
1925	6, 723, 962	38, 034, 488	19, 562	615, 512	45, 393, 524
1926	6, 934, 568	40, 691, 979	15, 493	651, 723	48, 293, 763
1927	6, 191, 727	38, 068, 335	9, 036	666, 087	44, 935, 185

FOREIGN TRADE IN STEEL

The following tables show the imports and exports of certain iron and steel products:

Iron and steel imported into the United States, 1925–1927

Article	1925		1926		1927	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Bar iron	11, 740	$538, 488	5, 624	$291, 239	4, 226	$193, 358
Boiler and other plate of iron and steel	818	50, 014	4, 945	143, 567	4, 034	125, 519
Iron and steel scrap	99, 815	1, 361, 342	86, 725	990, 565	60, 207	729, 334
Rails for railways	36, 872	1, 050, 578	55, 212	1, 449, 178	15, 455	422, 832
Sheets of iron or steel, skelp, saw plates and steel, n. e. s	3, 662	292, 155	10, 671	563, 073	15, 725	773, 319
Steel ingots, bars, etc	27, 081	1, 768, 784	30, 826	1, 323, 522	13, 672	706, 295
Tin and terne plates	381	107, 624	2, 160	297, 483	1, 064	191, 512
Wire and articles made from wire	--------	4, 611, 333	--------	5, 059, 623	--------	4, 135, 076
Wire rods	7, 988	539, 241	10, 074	691, 984	18, 881	942, 936
All other manufactures of iron and steel (not specially provided for)	--------	2, 244, 852	--------	3, 321, 138	--------	3, 751, 194

Iron and steel exported from the United States, 1926–27

Article	1926		1927	
	Gross tons	Value	Gross tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	7, 091	$372, 591	7, 053	$392, 008
Iron and steel bars and rods—				
Iron bars	5, 171	444, 975	3, 872	345, 032
Steel bars	137, 771	8, 934, 989	111, 126	6, 938, 199
Alloy-steel bars	4, 945	923, 475	6, 150	916, 389
Wire rods	19, 646	1, 085, 946	16, 127	883, 408
Iron and steel plates, sheets, skelp, and strips—				
Boiler plates	9, 035	445, 149	15, 539	686, 000
Other plates, not fabricated	129, 225	7, 156, 622	124, 090	6, 337, 570
Skelp iron or steel	93, 863	4, 181, 954	91, 561	3, 951, 879
Iron or steel sheets, galvanized	178, 634	18, 392, 449	152, 177	15, 498, 296
Steel sheets, black	175, 740	14, 194, 687	152, 523	12, 188, 391
Iron sheets, black	19, 253	2, 023, 754	17, 145	1, 662, 917
Strip steel, cold rolled	12, 810	1, 147, 811	11, 548	1, 024, 928
Hoop, band, and scroll iron or steel	34, 104	2, 305, 090	31, 612	2, 035, 677
Tin plate, terneplate, and taggers tin	250, 781	28, 766, 352	253, 888	29, 062, 466
Manufactures—steel-mill products:				
Structural iron and steel—				
Structural shapes—				
Not fabricated	157, 121	7, 655, 402	148, 176	6, 553, 994
Fabricated	28, 127	3, 019, 595	26, 084	2, 500, 271
Ship and tank plates, punched or shaped	5, 723	343, 266	7, 037	441, 223
Metal lath	4, 376	729, 202	4, 663	779, 236
Other structural shapes	43, 435	3, 589, 139	36, 303	2, 970, 263
Railway track material—				
Rails for railways	187, 557	7, 643, 232	177, 593	6, 783, 036
Rail joints, splice bars, fishplates, and tie-plates	27, 704	1, 676, 332	21, 403	1, 435, 750
Switches, frogs, and crossings	6, 502	1, 025, 020	6, 951	1, 149, 870
Railroad spikes	5, 528	387, 268	4, 432	308, 099
Railroad bolts, nuts, washers, and nut locks	2, 036	255, 119	1, 585	261, 526
Tubular products—				
Boiler tubes	18, 454	2, 203, 649	14, 713	1, 741, 090
Casing and oil-line pipe	132, 407	12, 598, 867	95, 764	9, 317, 963
Welded black pipe	84, 027	7, 704, 256	92, 149	7, 856, 224
Welded galvanized pipe	40, 563	4, 014, 834	45, 847	4, 383, 567
Malleable-iron screwed pipe fittings	12, 367	3, 433, 956	10, 064	3, 086, 111
Cast-iron screwed pipe fittings	10, 268	1, 980, 142	7, 253	1, 505, 903
Cast-iron pressure pipe and fittings	13, 118	1, 312, 751	11, 601	1, 235, 102
Cast-iron soil pipe and fittings	10, 726	801, 498	9, 121	694, 908
Wire and manufactures—				
Barbed	46, 565	3, 212, 353	47, 296	3, 155, 854
All other	51, 957	7, 664, 484	57, 384	7, 703, 609
Nails and bolts (except railroad)—				
Cut nails	1, 070	101, 098	1, 148	103, 455
Horseshoe nails	1, 055	278, 823	1, 079	267, 082
Wire nails	11, 743	885, 372	9, 991	762, 518
All other nails, including tacks and staples	5, 799	1, 255, 201	6, 203	1, 284, 693
Bolts, nuts, rivets, and washers (except railroad)	13, 221	2, 408, 704	12, 228	2, 196, 261
Castings and forgings—				
Horseshoes	660	102, 342	575	90, 699
Iron and steel, including car wheels and axles	36, 388	533, 007	40, 255	5, 261, 615
Advanced manufactures:				
House-heating boilers and radiators	....	392, 278	....	902, 457
Tools—				
Axes	....	1, 054, 626	....	1, 034, 195
Hammers and hatchets	....	363, 142	....	370, 485
Saws, wood and metal cutting	....	1, 901, 049	....	1, 996, 429
Shovels and spades	....	431, 859	....	416, 962
All other tools	....	13, 208, 123	....	12, 663, 209

ARSENIC, BISMUTH, SELENIUM, AND TELLURIUM[1]

ARSENIC

PRODUCTION AND SALES

Producers of refined and crude white arsenic (arsenious oxide) in the United States in 1927 reported an output of 11,730 short tons, of which 10,386 tons was refined and 1,344 tons was crude. Most of this output was a by-product of the lead and copper smelters, but it included also the output of the Jardine Mining Co. The companies producing refined white arsenic, crude white arsenic, flue dust, and treater dust for the market were the American Smelting & Refining Co., the Anaconda Copper Mining Co., the International Smelting Co., the Jardine Mining Co., and the United States Smelting, Refining & Mining Co.

No production of red arsenic sulphide or elemental arsenic was reported.

The total sales of refined and crude white arsenic by producers in 1927 amounted to 11,560 tons, valued at $725,360, or 3.137 cents a pound. The refined white arsenic, 10,020 tons, was sold for $647,680, or 3.232 cents a pound; the crude white arsenic, 1,540 tons, was sold for $77,680, or 2.522 cents a pound. The next table shows the white arsenic from all sources sold by producers in the United States in the last 10 years.

Crude and refined white arsenic sold by producers in the United States, 1918–1927

Year	Short tons		Value		Year	Short tons		Value	
	Refined	Crude	Total	Average (cents per pound)		Refined	Crude	Total	Average (cents per pound)
1918	[1] 6,323	....	$1,213,000	9.6	1923	12,327	1,914	$2,808,801	9.8
1919	[1] 6,029	....	1,181,284	9.8	1924	12,270	2,182	2,086,811	7.2
1920	10,942	560	2,021,556	8.8	1925	11,240	1,077	1,198,247	4.9
1921	3,427	1,359	717,700	7.5	1926	10,977	828	674,358	2.9
1922	8,905	1,122	1,475,229	7.4	1927	10,020	1,540	725,360	3.1

[1] Part of the output in 1918 and 1919 was elemental arsenic, but the elemental arsenic produced in 1920 and 1921 is not included in the table, as it was reduced from white arsenic purchased on the market. No elemental arsenic was produced from 1922 to 1927.

IMPORTS

Imports of white arsenic increased from 7,703 short tons in 1926 to 12,517 tons in 1927. Most of the white arsenic, or 9,375 tons, was imported from Mexico. Imports of white arsenic into the United States from Canada were 1,848 tons and from Japan 1,079 tons. The other imports were from Belgium and Germany.

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[1] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Arsenic compounds and metallic arsenic imported for consumption in the United States, 1918–1927

Year	Arsenious acid (White arsenic, As₂O₃)		Arsenic sulphide (realgar and orpiment)		Sheep dip		Paris green and London purple	
	Short tons	Value	Short tons	Value	Pounds	Value	Pounds	Value
1918	1,847	$401,212	4,842	$848,608	(1)	$26,535		
1919	4,355	926,495	2,171	376,067	161,802	12,647	13	$14
1920	5,746	782,035	4,080	664,301	70,135	5,135	377	277
1921	1,962	255,290	2,746	531,025	64,577	4,902	288	128
1922	1,461	112,186	3,622	571,644	75,739	4,977	1,886	741
1923	10,187	1,281,410	1,037	288,611	67,775	5,287	100,751	21,588
1924	9,677	1,097,825	224	47,265	134,895	10,734	70,541	11,697
1925	9,016	1,078,671	473	61,298	178,477	4,863	2,686	702
1926	7,726	750,537	289	45,738	176,767	14,670	4,747	1,431
1927	12,517	921,995	205	31,085	104,804	9,882		

Year	Arsenic acid (H₃AsO₄)		Calcium arsenate		Lead arsenate		Metallic arsenic	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1918–1922	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1922 (2)	41,294	$4,737					21,497	$1,454
1923	185,164	11,867			25	$8	174,208	37,654
1924	420	122	3,172	$575	1,540	222	121,467	21,694
1925	58,111	2,877	1,374	182	16,467	1,534	183,167	71,735
1926	2,747	303	1,667	298			173,499	55,741
1927	11,592	474	5,887	717			245,686	47,376

[1] Figures not available.

[2] Figures cover period Sept. 22 to Dec. 31. Not separately classified prior to change in tariff.

White arsenic imported into the United States in 1927, by countries and districts

[General imports]

Country	Short tons	Value		District	Short tons	Value
		Total	Average value per pound			
Belgium	105	$14,236	6.8	Buffalo	522	$38,324
Canada	1,846	124,287	3.4	El Paso	2,377	202,929
Germany	17	1,192	3.5	Los Angeles	47	2,507
Japan (Chosen)	1,078	64,627	3.0	Maryland	121	8,624
Mexico	9,471	716,854	3.8	Massachusetts	50	3,000
				Michigan	964	67,621
				New York	4,380	347,238
				Ohio	220	15,737
				Philadelphia	84	7,080
				St. Louis	5	608
				San Antonio	2,414	177,508
				San Francisco	636	50,158
	12,517	$921,995	3.7		12,517	$921,995

PRICES

In 1927 the price quoted in New York for white arsenic, delivered at consuming point, was 3.5 to 3.75 cents a pound in January; during the next five months the price was steady at 3.75 cents a pound; by the end of July the price had increased to 4 cents and was steady at that figure to the end of the year.

BISMUTH

Bismuth was reported recovered by one refining establishment in the United States in 1927. Figures of production are not available for publication.

Bismuth imported for consumption in the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	135, 700	$277, 273	1923 [1]	62, 640	$146, 178
1919	57, 607	55, 179	1924 [1]	18, 494	39, 653
1920	72, 771	161, 877	1925 [1]	99, 694	187, 340
1921	94, 085	114, 891	1926 [1]	67, 505	173, 285
1922 [1]	121, 505	239, 777	1927 [1]	47, 732	100, 773

[1] Also 9,392 pounds of "compounds, mixtures, and salts of bismuth," valued at $8,681, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff. Similar additional imports in 1923 were 11,731 pounds, valued at $13,717; in 1924, 10,066 pounds, $12,533; in 1925, 16,983 pounds, $18,958; 1926, 12,864 pounds, $18,864; and in 1927, 10,560 pounds, $15,080.

In 1927 the quoted price for bismuth, New York, in ton lots, was $2.70 to $2.75 per pound during January, February, and March; $2.20 to $2.25 during April, May, and June; and $1.85 to $2.10 during the remainder of the year. Bismuth was quoted in London at 10s. a pound during the first three months and at 8s. during the remainder of the year.

SELENIUM

Three companies reported an output of 377,278 pounds of selenium in 1927, compared with 260,005 pounds in 1926.

The annual sales of selenium in the form of small pigs, in sticks one-half inch thick and about 4 inches long, and in fairly coarse powder are given in the table following.

Selenium sold by producers and in stock at producers' plants in the United States, 1921–1927

Year	Sales			Stock at end of year (pounds)
	Pounds	Value		
		Total	Average	
1921	55, 978	$89, 148	$1. 59	----------
1922	123, 565	177, 542	1. 44	----------
1923	127, 174	237, 196	1. 86	677
1924	153, 762	286, 066	1. 86	48, 419
1925	194, 007	330, 637	1. 70	61, 775
1926	252, 312	438, 132	1. 74	72, 374
1927	284, 508	491, 996	1. 73	158, 494

Selenium and selenium salts imported for consumption in the United States, 1921–1927

Year	Pounds	Value	Year	Pounds	Value
1921	1, 106	$2, 099	1925	5, 807	$10, 582
1922	1, 652	2, 530	1926	18, 885	34, 680
1923	940	1, 653	1927	15, 286	28, 199
1924	300	606			

Quotations in New York for selenium delivered at consuming point were $1.90 to $2 a pound throughout 1927.

TELLURIUM

The total output of tellurium in 1927 was 1,659 pounds, compared with 917 pounds in 1926. The sales in 1927 amounted to 1,003 pounds, valued at $1,913, or an average of $1.91 a pound, compared with 1,106 pounds, valued at $2,229, or $2.02 a pound, in 1926. At the end of 1927 the quantity of tellurium in stock at producers' plants was 2,337 pounds.

TIN

By J. W. FURNESS[1]

STATISTICAL SUMMARY

Summary of statistics for tin in the United States, 1926–27

	1926	1927
Production...long tons..	7.14	24
Monthly price of Straits tin in New York:		
Highest...cents per pound..	70.67	69.31
Lowest...do....	60.62	57.63
Average...do....	65.30	64.37
Imports for consumption...long tons..	77,159	71,142
Exports (domestic and foreign)...do....	1,980	2,239
Reclaimed tin...do....	29,821	32,946

INTRODUCTION

Alaska and South Dakota were the only areas in the United States where tin ore was produced in 1927. The production of Alaska for 1927, as reported by the United States Geological Survey, was 23.9 long tons of metallic tin, in 33.5 long tons of cassiterite concentrates; the shipments were 23.7 long tons of metallic tin, in 33.2 long tons of concentrates, which at the average price for metallic tin had a calculated value of $34,200. The shipments were probably consigned to the Straits Trading Co. (Ltd.), Singapore, for smelting and refining. The production of Alaska for 1926 was 7.14 long tons of tin, in concentrates, valued at $10,400. In the Black Hills of South Dakota 500 pounds of tin concentrates, containing 65 per cent metallic tin, were produced in 1927.

The apparent total tin available for consumption in the United States in 1927 was 102,000 tons. This figure is derived by adding the figures for production of primary metal, imports for consumption, and recovery of reclaimed tin and deducting from the total the figures for metal exported.

The imports of tin ore or concentrates in 1927 contained 122 long tons of metallic tin, and the imports of tin in bars, pigs, blocks, etc., were 71,142 long tons, as compared with 303 long tons of tin in ore and 77,159 long tons in bars, pigs, etc., in 1926. The value of the imports of tin in bars, pigs, etc., was $100,865,205 in 1927, as compared with $104,793,396 in 1926. The average New York price per long ton of Straits tin in 1927 was $1,441.89, a decrease of $20.83, as compared with 1926.

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[1] Figures on imports into and exports from the United States compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

NOTE.—Since this report was written (May, 1928) the author has been pleased to note the appearance, in the Mining Journal of London, of articles that corroborate his analysis of the world tin situation. These articles appeared too late for the inclusion of citations the author would like to have made.

In 1927 the recovery of reclaimed tin was 3,125 tons more than in 1926, when the recovery was 29,821 long tons. A review of the yearly record of the reclaimed tin recovery and the annual imports of tin brings out the fact that secondary tin is playing an ever-increasing part in the field of domestic consumption. The quantity of tin reclaimed annually is more or less influenced by the price of virgin tin and, in the opinion of the author, the reciprocal effect of the recovered metal upon the price of virgin tin has not been given sufficient consideration in the past. Data are not available on the secondary metal industries of any country except the United States, an unfortunate fact, as the tonnage of reclaimed tin constitutes one of the major elements in the world's consumption of tin. Viewing the world as a whole from the standpoint of a producer, the year 1927 opened with a market for tin in an extremely strong position. The imports of the United States in 1926 were the largest ever attained. The average price for Straits tin in New York in 1926 was 65.30 cents a pound, and the closing price for the year was 66.75 cents.

At the beginning of 1927 the world's visible stock of tin was 16,326 long tons, a supply that might be regarded as normal or moderate in comparison with the supply in other years. For example, at the end of 1923 the world's visible supply was 21,740 tons, in addition to which about 20,000 tons was pooled under the Bandoeng agreement; and for the 5-year period 1910 to 1914 the visible supply of tin ranged between 12,000 and 19,000 tons. Thus by contrast with the situation in earlier years a seller's market is indicated at the opening of 1927. In the first quarter the price of tin advanced to 71 cents per pound. After March, however, the price declined steadily until the close of the year, because in the second quarter of 1927 it became apparent that the world's production for the year would probably be greater than that attained in any year theretofore. The events of the year substantiated this prediction, and when the year closed it was seen that the world's production amounted to 12,000 tons more than in 1926. This increase is attributed in the main to the increased production of the Federated Malay States, Bolivia, Netherland East Indies, and Nigeria. Nevertheless the year closed with a reduction of the visible supply to 15,733 tons, and the closing price was 57.875 cents.

During the past few years the world price of tin has in the main been greatly influenced by the business conditions in the United States. As stated in the 1926 chapter of this series, during the past few years the United States has acquired a constantly increasing percentage of the world's output and is the world's largest consumer. In 1927 the imports of virgin tin into the United States were 6,017 tons less than in 1926. There was a decrease of more than 100,000 tons in the manufacture of tin plate in the United States as compared with 1926. This decrease in tin-plate manufacture was approximately equivalent to 2,000 tons of virgin tin. The decreased consumption in this industry does not indicate a tendency in that direction but is due to the fact that at the close of 1926 there was a large holdover stock of canned goods. During 1927 there was a very material decrease in the fish, meat, vegetable, and fruit pack. Also approximately a million less automobiles were produced, representing a decrease of approximately 5,000 tons in the consumption of virgin tin. In addition to the curtailments mentioned the consumption of babbitt, according to the Bureau of the Census, decreased 6,000,000 pounds in 1927 as compared with 1926. This decrease indicates an approximate curtailment of 2,400 tons of the virgin tin required by this industry and was due, no doubt, in the main to the lower production in the automobile industry. Considering that the amount of tin available for domestic consumption in 1927 was only 3,000 tons less than in 1926 and that there was but a slight difference between the two years as to stocks on hand, the curtailment in the consumption of tin in the uses enumerated seemingly is not indicated by the statistics herein presented. The inference to be drawn is that stocks in the hands of manufacturers must have increased materially.

The world's increased production was absorbed in part by the increase of imports into Germany in 1927. The imports of France and England also increased. The increase of continental European consumption may be attributed to the fact that after March, 1927, the price of tin was descending, and for the last six months of the year the tin market became a buyer's and not a producer's market. An inference that might be drawn from the conditions outlined is that at price levels above those of 1927 in continental Europe substitution takes place and consumption is immediately affected. This would seem to the author to be nearer the truth than to suppose that the tin purchased in Europe during the last quarter of 1927 was for speculative purposes.

Through the centuries in which tin has been used by the human race many of the so-called needs supplied by this metal are in reality those of convenience rather than of necessity. In the present scheme of civilization probably the most essential use to which tin is put is in the manufacture of containers, making possible the utilization of food products out of season and their transportation and conservation. The rapid growth of the canning industry has called for an ever-increasing tonnage of tin, which has been met by gradual increase of world production. The rapid growth of the automobile industry, which in 1926 utilized more than 16,000 tons of tin in the United States, has caused in part at least rapid expansion of the world's production. Considering the manifold uses of tin, the greater part of the tin consumed is acquired by the tin-plate industry and in the manufacture of babbitt bearing metals, of solder, and of brasses and bronzes. The four uses enumerated are the major factors that control consumption. In the past consumption has been on the heels of production, so any curtailment in these basic uses must react rapidly upon consumption and therefore upon price and eventually upon production.

W. R. H. Chappel, chairman at the annual meeting of the Rambutan (Ltd.) Tin Mining & Dredging Co., in reviewing the immediate future of tin, stated:[2]

> I am not pessimistic about the future of tin, but I do not think that we can expect during the next three or four years the high level of prices that we have experienced during the last two years. The increase of new tin-winning equip-

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[2] Mining Journal (London), Jan. 14, 1928, p. 40.

ment all over the world should produce more tin than is required to compensate for those areas that are worked out or unpayable and the probable increased demand of the world's trade.

Notwithstanding the industrial importance of tin, it may be considered comparatively cheap and in the past has been marketed with ease. This has made the producer extremely complacent, and little effort has been made in research looking toward expansion of demand that might be created by new uses. The high price of tin during the past two years has offered sufficient inducement to those engaged in research for greater activities along the lines of substitution than have existed for many years. It is also interesting to note that in 1923, when the average price of tin at New York was 42.71 cents per pound, the recovery of reclaimed tin in the United States amounted to 26,973 tons, indicating that even at this low price level the salvaging of tin is an attractive business. During 1927 it was suggested that the price of tin be stabilized at £300 (approximately $0.65 per pound). Should the proposed pegging of the price be attained and the price be maintained at £300, the natural impetus given to the salvage industry would make it difficult to control the output of virgin material. It is the opinion of some that if the price of tin is to be more or less stabilized it may be accomplished by collective buying by the American consumer, thus eliminating competitive bidding and in part speculation. The price situation may also be improved by increasing the demand through research work.

In 1927 the opening price of the year was 67.5 cents per pound. There was a slight decline to 64.875 cents during the first month, and then there was a gradual rise in price, until tin reached the highest price of the year, 71 cents, on February 25. From this figure the price declined steadily, and in November reached 56.125 cents, the low point of the year. From this point it increased slightly, closing at 57.875 cents. In February, 1928, the current price was about 24 per cent less than it was the year before, while the current visible supply of tin increased about 2,000 tons. The large amount of capital invested during 1927 and the declining price associated with the increased world's production have led to a considerable amount of agitation by new producers for the stabilization of price, and there has been a considerable amount of publicity on the subject of the feasibility of establishing an international agreement among the producers to peg the price at £300. Lord Asquith in a speech delivered before the Royal Colonial Institute urged that all British companies be merged into one great tin trust, or at least adopt cooperative selling methods.[3]

At the annual meeting of the Tekka (Ltd.) Tin Mining Co. W. R. H. Chappel, chairman, discussed the proposed stabilization of price[4] by agreement among the mines to limit their production or to stop their shipments, holding them in reserve. To limit the output disorganizes the mining personnel and also increases the cost of production, as overhead charges remain relatively constant. As to the second alternative—holding output in reserve—he states:

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[3] Washington Post, Feb. 23, 1928, p. 6.

[4] Mining Journal (London), Nov. 12, 1927, p. 959.

> It seems to me a suicidal policy; it would not only upset all our present financial working arrangements but would be creating a weapon which could be used against us, as directly it was known that there was an accumulation of tin ready to come on the market we would have the "Bandoeng Pool" situation over again, from which we suffered so much until it was liquidated.

In the Financial Times of London October 18, 1927, an outline was given of the tin-market control proposal in which stabilizing the price at £300 was outlined. The consensus in the general trade, judging by various trade journals both in Europe and America, was that the scheme was not practical. So many divergent interests were involved it was not considered possible that all producers could be made to cooperate, and it was regarded as doubtful that any plan providing for restriction of output could actually be made effective without Government supervision by tin-producing countries. From time to time there have been rumors of the formation of a tin syndicate. In the latter part of 1923 there was reported to have been held in London a conference of some of the tin producers with the avowed purpose of taking concerted action to stabilize prices. It is supposed that an agreement was entered into. This supposition is substantiated to a large degree by subsequent events. The world's visible supply of tin was gradually reduced from about 25,000 tons at the end of 1922 to about 16,000 tons at the end of 1926. During this period the price steadily advanced until 72.50 cents was reached in November, 1926. The increased consumption during the past, with its resultant ascending price, had not necessitated or created the urge to attempt to form a producers' association until the fall of 1927, when the price declined rapidly and it became apparent that visible stocks might increase materially in 1928.

Another significant development of the year was the establishment of a French company known as the Société d'Electrochimie et d'Electrométallurgie, which began operations at its new plant at Giffre for the treating of tin ore under a patented process.[5] This indicates the desire on the part of France for commercial independence in the matter of tin supply.

As has been stated, the decline in consumption of tin in the canning industry in 1927, as compared with 1926, as well as the other factors enumerated, unquestionably has had and will have an effect upon the immediate consumption of the metal. It appears as if there would be in the near future an increase in world production. It does not seem likely that this increase of production will be absorbed by the consumption of tin with the price of the metal at the 1927 range.

DOMESTIC PRODUCTION

Tin mined in the United States (including Alaska), 1918–1927, in long tons

[Metallic tin obtainable from concentrates produced in tin mining]

1918	62	1923	1.7
1919	50	1924	6.3
1920	20	1925	12.3
1921	3.6	1926	7.14
1922	1.3	1927	24

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[5] Reagan, D. J., assistant commercial attaché, Paris, France, Economic and Trade Notes 8, Series No. 49, June 21, 1927.

Smelter output of metallic tin in the United States, 1918–1927, in long tons

1918	9,182	1922	8,132
1919	10,925	1923	6,666
1920	15,761	1924	434
1921	10,305	1925–1927	-----

SECONDARY TIN

The recovery of secondary tin as metal and in alloys and chemical compounds in the United States in the past 10 years has been as follows:

Secondary tin recovered as metal and in alloys and chemical compounds in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	21,283	$41,381,000	1923	26,973	$25,316,000
1919	21,458	29,868,200	1924	27,946	31,062,100
1920	20,982	22,705,700	1925	27,634	35,165,400
1921	15,089	9,668,500	1926	29,821	42,511,500
1922	17,420	12,443,500	1927	32,946	46,302,100

The domestic tin-reclamation industry has been supplemented by the establishment in 1927 of a detinning plant at Brantford, Ontario, Canada. The plant has a capacity of about 10 tons of tin-plate scrap a day. The tin is to be recovered by the chlorine process.[6]

IMPORTS AND EXPORTS

Tin concentrate imported into the United States, 1918–1927

[General imports]

Year	Long tons	Value	Year	Long tons	Value
1918	16,423	$11,444,401	1923	2,692	$2,169,055
1919	17,139	11,871,948	1924	[1] 155	71,094
1920	30,489	18,795,162	1925	[1] 191	98,489
1921	13,696	5,672,861	1926	[1] 303	187,396
1922	12,325	5,504,434	1927	[1] 122	79,089

[1] Recorded as tin content.

Tin content of tin ore, cassiterite, and black oxide of tin imported into the United States, 1926–27, by countries

[General imports]

Country	1926		1927	
	Long tons	Value	Long tons	Value
Bolivia	172	$101,436	13	$6,466
Canada	93	61,108	103	70,066
Cuba	(a)	54	----	----
Denmark	----	----	2	1,572
Germany	34	23,190	(a)	5
Honduras	----	----	(a)	100
Mexico	4	1,446	----	----
Netherlands	(a)	162	----	----
United Kingdom	----	----	4	880
	303	187,396	122	79,089

[a] Less than 1 ton.

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[6] American Metal Market, Aug. 26, 1927, p. 4.

Metallic tin imported for consumption in the United States, 1918–1927

Year	Long tons	Value	Year	Long tons	Value
1918	63, 620	$93, 144, 218	1923	68, 934	$61, 092, 354
1919	40, 044	50, 880, 019	1924	65, 059	68, 953, 193
1920	56, 067	73, 440, 872	1925	76, 646	95, 121, 111
1921	24, 197	16, 645, 719	1926	77, 159	104, 793, 396
1922	60, 193	40, 797, 986	1927	71, 142	100, 865, 205

Metallic tin (bars, pigs, blocks, grains, and granulated) imported into the United States, 1926–27, by countries

[General imports]

Country	1926		1927	
	Long tons	Value	Long tons	Value
Australia	867	$1, 204, 155	670	$951, 646
Belgium	106	148, 046	25	37, 087
Bolivia	(1)	500		
Canada	75	18, 485	25	31, 212
Chile	4	4, 131		
China	215	304, 678		
France	87	129, 814	15	22, 307
Germany	437	618, 336	1, 306	1, 869, 956
Guiana (British)	175	223, 188		
Hong Kong	2, 549	3, 514, 606	1, 971	2, 787, 177
Irish Free State	100	133, 399		
Japan			25	34, 351
Java and Madura	1, 821	2, 416, 877	263	373, 203
Malaya (British) (Straits Settlements)	42, 786	56, 326, 508	45, 094	64, 025, 672
Mexico	(1)	83		
Netherlands	7, 173	10, 420, 732	7, 755	11, 405, 379
Panama			25	34, 974
Philippine Islands			5	7, 236
Sweden	(1)	37		
United Kingdom	20, 764	29, 329, 821	13, 963	19, 285, 005
	77, 159	104, 793, 396	71, 142	100, 865, 205

[1] Less than 1 ton.

Metallic tin exported from the United States, 1918–1927, in long tons

Year	Domestic [1]	Foreign [2]	Year	Domestic [1]	Foreign [2]
1918	18	236	1923	750	296
1919	273	68	1924	419	540
1920	630	297	1925	361	571
1921	1, 030	363	1926	675	1, 305
1922	804	294	1927	1, 010	1, 229

[1] Imported as ore and exported as pigs, bars, etc.
[2] Imported as pigs, bars, etc., and exported as such.

DOMESTIC MINING SITUATION

During 1927 the mining of tin was confined to Alaska and to the Harney Peak area of South Dakota.

ALASKA

The production of tin ore in Alaska in 1927 was from the Seward Peninsula and the Yukon Valley. According to the United States Geological Survey, the 33.5 long tons of concentrates produced contained approximately 23.9 long tons of tin.

SOUTH DAKOTA

In the Black Hills of South Dakota 500 pounds of tin concentrates, containing 65 per cent metallic tin, were produced in 1927.

The following statement was prepared by Frank L. Hess, of the Bureau of Mines:

Tin-bearing pegmatites at Tinton, on Nigger Hill, in the northwest part of the Black Hills, have been known and located for their tin content since the tin excitement in the southern Black Hills in the eighties, and several serious attempts have been made to mine the pegmatites for tin. The geology of the area has been covered by Darton.[7] Tinton is at the west edge of South Dakota, and the Tinton company, which attempted a few years ago to exploit the tin deposits, had its mill just across the line in Wyoming. The Black Hills Tin Co. has taken over the property and erected a new mill a few hundred feet east of the line and will also attack the main pegmatite which it is claimed can be followed between 3,000 and 4,000 feet along the strike. The pegmatite is intercalated in quartz mica schists which strike northwest and have a steep dip to the southwest. The country is fairly well timbered and the pegmatite is covered with soil in so many places that it is not easy to be sure that it is continuous through this distance, although bodies of pegmatite may be seen at various points along the strike for the distance given. At least part if not all of the pegmatite was originally a quartz vein. It has been roughly sheeted parallel to the schistosity of the country and along the cracks between the sheets solutions from a granitic magma have extensively but irregularly replaced the quartz.

On the Rough and Ready claim, on which the most work has been done and on which it is expected to do work in the future, the pegmatite mass is at least 420 feet wide, as shown by underground workings, but this possibly is due to a local widening or branching. The mass of the pegmatite is albite which has apparently in part, at least, replaced microcline which had previously replaced the original quartz. There is considerable mica, especially on the hanging side, in small masses which reach, at the greatest, about 2 inches across, but most are less than an inch across. The cassiterite occurs both with the mica and with the albite. The albite is mixed with white quartz and is frequently so fine as to make the mass look sugary. In these places most of the cassiterite is in very fine grains, so that it is described as "pepper tin." Heretofore it has been impossible to make the tin pay for working. In a private report made on the tin property by A. E. Thomas in 1914 a considerable part of the pegmatite on the Rough and Ready claim showed a content of 1 to 28 pounds of tin per ton, though there were two short drifts which showed only traces. The Black Hills Tin Co. intends to save not only the tin, but the mica, which it expects to grind.

According to surveys by G. V. Bland, made by sampling, crushing, and panning, the tin-bearing pegmatite carries from 1.3 to 25.2 per cent of muscovite, and vibrating screens have been invented by John Bland for separating the mica from the crushed rock. Few definite relationships have been made out between the mica and the tin, but the particles of cassiterite are larger where the mica is coarse, though in general it seems to be true that the tin increases in quantity at the expense of the mica. This would seem to be more or less characteristic of a pegmatite, for although mica is one of the less easily replaced minerals, cassiterite is one of the latest minerals to be introduced and is deposited at a time when most of the early minerals, of which mica is one, are being removed to make way for the high temperature minerals.

The fact that the pegmatite has replaced a sheeted quartz vein makes for regularity in the deposition of the minerals because the solutions have followed the narrow channels formed by the cracks, and it seems probable that more or less definite ore shoots may be found in the deposit, owing to this peculiarity in its origin. This, so far as I know, is unknown in other pegmatitic deposits.

A little columbite has been found in the Rough and Ready claim, and in another part of the vein a couple of hundred yards south in the same pegmatite a considerable quantity of columbite has been uncovered.

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[7] Darton, N. H., Sundance Folio, U. S. Geol. Survey Geol. Atlas No. 127, 1905.

Although common in the southern part of the Black Hills, no lithia minerals have been found in the pegmatites of the northern Hills.

During 1927 a few hundred pounds of stream tin was sluiced from Bear Gulch on the east side of Nigger Hill.

PRICES AND STOCKS

The effect of the further depletion of the world's visible supply of tin was not reflected by an increased price in 1927. The average price of tin at New York for the year was 64.37 cents per pound, a decrease of 0.93 cent from that for 1926. The average London price per long ton of standard tin in 1927 was £289 1s. 5d. According to Metal Statistics, the world's visible supply of tin on December 31, 1924, was 25,088 long tons, and on December 31, 1926, it was 16,326 tons, a decrease of 35 per cent. On December 31, 1927, the visible supply had further decreased by 593 tons to 15,733 tons, a decline of 37 per cent during the 3-year period.

Monthly price of Straits tin for prompt delivery in New York, 1925–1927, in cents per pound[1]

	1925			1926			1927		
	High	Low	Average	High	Low	Average	High	Low	Average
January	60.50	56.00	58.23	63.50	60.75	62.27	67.62½	64.87½	66.47
February	57.75	56.30	57.08	64.50	62.00	63.62	71.00	66.50	69.06
March	55.25	52.12½	53.72	66.00	63.00	64.49	70.50	68.00	69.31
April	56.00	50.00	52.21	64.25	62.25	63.38	70.00	66.12½	68.02
May	56.25	53.37½	54.67	64.50	60.50	62.44	68.50	66.62½	67.52
June	57.12½	54.87½	55.92	62.12½	58.50	60.62	68.25	66.00	67.42
July	59.37½	57.25	58.08	64.25	61.70	63.07	65.75	63.37½	64.06
August	59.37½	56.75	58.18	66.25	64.12½	65.28	65.62½	63.50	64.47
September	59.87½	56.50	58.27	71.00	65.87½	68.92	63.75	57.87½	61.49
October	64.12½	60.00	62.23	71.75	68.25	70.31	59.50	57.50	58.50
November	64.50	62.12½	63.27	72.50	68.00	70.67	59.12½	56.12½	57.63
December	63.75	61.25	62.93	71.25	66.50	68.47	59.37½	57.75	58.49
Year	64.50	50.00	57.90	72.50	58.50	65.30	71.00	56.12½	64.37

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[1] Metal Statistics, 1928, pp. 339 and 341.

In the first quarter of 1927 shipments of smelter product from Malay were 18,611 tons, 1,010 tons larger than in the same period of 1926. The total tonnage available to world commerce for the first quarter of 1927 was 28,516 tons, or 1,505 tons more than in the corresponding period of 1926. During the first quarter of 1927 the price of tin at New York rose from an average of 66.47 cents for January to an average of 69.31 cents for March; the highest price of the year in New York was on February 25, when tin sold for 71 cents per pound, spot. At the close of the first quarter of 1927 spot stocks in London were 2,193 tons, or 91 tons less than the 2,284 tons in stock on the corresponding date in 1926. The imports of tin in bars, pigs, etc., into the United States during the first quarter of 1927 were 18,616 tons, compared with 20,296 tons for the corresponding quarter of 1926. The visible supply in the United States at the close of the first quarter of 1927 was 8,969 tons, or 58 per cent of the world's visible supply of 15,441 tons. During the first quarter of 1927, 10,650,000 base boxes of tin plate were manufactured, indicating an increase of 750,000 boxes over the corresponding period of 1926.

At the opening of the last quarter of 1927 the world's visible supply of tin had increased to 15,083 tons, of which 9,529 tons, or 63 per cent, was accounted for in the United States. The world's deliveries of tin for the first 9 months of 1927 were 88,995 tons, as compared with 90,529 tons for the same period of 1926. The deliveries of tin into the United States in 1927 were decidedly less than in the preceding year, but a large part of this decrease was offset by increased deliveries to continental Europe.

The price of tin in December opened at 59 cents a pound and closed at 57.875 cents. The production of tin plate during the last quarter of 1927, when the tin-plate mills were operating at 60 per cent of capacity, was the lowest during any quarter of 1927, namely, 7,300,000 base boxes, as compared with 10,600,000 boxes for the corresponding quarter of 1926. The production of base boxes in 1927 was 36,100,000, as compared with 40,400,000 for 1926, a decrease of 10.64 per cent. Exports, however, increased in 1927 and amounted to 5,692,532 boxes, or 74,905 boxes more than in 1926. The decrease in the production of base boxes of tin plate may be largely attributed to the slump in the canning industry.

PRINCIPAL PRODUCTS

TIN AND TERNE PLATE

United States.—According to the American Iron and Steel Institute, the domestic output of tin plate in 1927 was 1,568,525 long tons, a decrease of 105,797 tons as compared with 1,674,322 tons produced in 1926. This decrease may be attributed in the main as follows: In the early fall of 1927 there was little demand for tin plate, and the mills were operating on a 60 per cent capacity basis. As tin plate is largely used in the manufacture of food containers, the following figures become pertinent. According to the statistics collected by the Bureau of the Census the vegetable pack (expressed in terms of cases of 24 No. 2 cans) was 19,069,000 cases of corn in 1926 and 10,346,680 cases in 1927; the green and wax bean pack was 4,037,000 cases in 1926 and 4,676,767 cases in 1927; and the pea pack was 17.709,000 cases in 1926 and 12,937.017 cases in 1927. The fish pack in 1927 was 50 per cent of that in 1926. This clearly illustrates the influence of the packing industry on the consumption of tin plate.

The lack of domestic consumption was to a small extent offset by the increased exports for the year. The total exports of tin plate, terneplate, and taggers tin were 253.888 long tons in 1927, compared with 250,781 tons in 1926, an increase of slightly more than 1 per cent.

In 1927 there were 105,066 long tons of terneplate manufactured, as compared with 107,984 tons in 1926.

Tin plate and terneplate produced in the United States, 1918–1927, in long tons[1]

Year	Tin plate	Terneplate	Total	Year	Tin plate	Terneplate	Total
1918	1, 435, 825	38, 114	1, 473, 939	1923	1, 414, 404	92, 458	1, 506, 862
1919	1, 074, 624	76, 723	1, 151, 347	1924	1, 328, 228	90, 426	1, 418, 654
1920	1, 374, 979	70, 566	1, 445, 545	1925	1, 544, 007	113, 788	1, 657, 795
1921	747, 911	46, 363	794, 274	1926	1, 674, 322	107, 984	1, 782, 306
1922	1, 208, 772	79, 123	1, 287, 895	1927	1, 568, 525	105, 066	1, 673, 591

[1] From Annual Report of American Iron and Steel Institute.

Tin plate, terneplate, and taggers tin imported into the United States, 1926–27, by countries and by districts

	1926		1927	
	Long tons	Value	Long tons	Value
COUNTRY				
Canada	46	$14, 590	20	$6, 619
Germany	1	359	(1)	161
United Kingdom	2, 113	282, 534	1, 044	184, 732
	2, 160	297, 483	1, 064	191, 512
DISTRICT				
Buffalo	1	339		
Los Angeles	9	2, 763	5	1, 448
Massachusetts	4	1, 070	30	8, 587
Michigan	(1)	11	11	2, 845
New Orleans	21	2, 948	39	12, 681
New York	51	15, 491		
Ohio	12	3, 445	22	6, 371
Oregon	5	1, 728		
Philadelphia	101	29, 612	71	19, 160
Pittsburgh	(1)	9	92	28, 725
St. Lawrence	34	10, 552	22	6, 454
San Francisco	1, 817	200, 981	695	81, 496
Vermont	17	5, 356	16	4, 995
Washington	17	2, 314	3	800
Wisconsin	71	20, 864	58	17, 950
	2, 160	297, 483	1, 064	191, 512

[1] Less than 1 ton.

Tin plate, terneplate, and taggers tin exported from the United States, 1926–27, by countries and by districts

	1926		1927	
	Long tons	Value	Long tons	Value
COUNTRY				
North America:				
Canada	46, 954	$5, 902, 242	41, 919	$5, 249, 123
Central America—				
Costa Rica	21	3, 069	12	1, 876
Guatemala	53	6, 159	46	5, 832
Honduras	12	1, 470	1	86
Nicaragua	2	262	18	2, 352
Panama	4	882	139	11, 288
Salvador	38	5, 630	32	4, 237
Mexico	9, 351	1, 021, 330	12, 079	1, 314, 552
Newfoundland and Labrador	143	16, 258	146	16, 265
West Indies—				
British—				
Jamaica	47	5, 090	49	5, 486
Trinidad and Tobago	83	9, 204	27	3, 082
Other	48	5, 124	(1)	26
Cuba	3, 125	339, 360	3, 763	408, 586
Dominican Republic	14	2, 194	34	5, 902
Dutch	346	38, 856	355	38, 513
Haiti	8	1, 422	14	2, 083
South America:				
Argentina	16, 573	1, 855, 829	33, 415	3, 606, 168
Bolivia	10	1, 166	26	2, 872
Brazil	5, 857	624, 104	9, 727	1, 026, 872
Chile	7, 031	757, 577	5, 804	606, 949
Colombia	2, 364	277, 669	2, 474	280, 688
Ecuador	38	5, 063	10	1, 068
Guiana, Netherland (Surinam)	22	2, 510	55	6, 573
Paraguay			34	3, 681
Peru	3, 489	335, 535	4, 081	427, 447
Uruguay	2, 938	346, 638	5, 755	621, 397
Venezuela	612	68, 774	894	97, 595

[1] Less than 1 ton.

Tin plate, terneplate, and taggers tin exported from the United States, 1926–27, by countries and by districts—Continued

	1926		1927	
	Long tons	Value	Long tons	Value
COUNTRY—continued				
Europe:				
Austria	11	$1,242		
Belgium	277	29,826	342	$36,725
Bulgaria	312	54,460	725	79,899
Czechoslovakia			29	3,555
Denmark and Faroe Islands	1,835	207,591	1,006	109,206
Finland	15	1,511	36	3,857
France	142	18,076	267	32,155
Germany	8	1,477	2	190
Greece	1,935	209,956	3,121	351,274
Italy	10,126	1,162,175	8,282	996,591
Malta, Gozo, and Cyprus Islands	95	10,489		
Netherlands	3,170	353,266	906	98,794
Norway	2,327	256,259	1,508	153,576
Portugal	517	58,250	147	16,333
Rumania			170	19,181
Soviet Russia	237	26,277	784	87,794
Spain	1,222	139,043	593	69,341
Sweden	402	45,840	761	79,442
Switzerland			198	21,600
Turkey	2,615	292,991	3,170	353,915
United Kingdom	6,604	740,391	4,192	494,679
Yugoslavia and Albania			107	12,828
Asia:				
Ceylon	82	9,189	49	10,554
China	24,178	2,707,223	20,066	2,146,024
East Indies—				
British—				
India	14,592	1,669,791	8,921	981,931
Malaya (Straits Settlements)	6,881	745,271	2,109	239,362
Netherland	1,891	205,907	759	87,541
French Indo-China			79	8,601
Hongkong	910	101,509	2,404	313,826
Japan (including Chosen)	49,064	5,628,834	54,684	6,538,197
Java and Madura	6,475	733,158	3,830	462,475
Kwantung	29	3,580	34	3,547
Palestine	34	3,677		
Persia	(1)	6		
Philippine Islands	4,254	481,388	4,068	447,105
Soviet Russia	138	15,680	1,888	208,475
Syria			47	4,545
Turkey	377	44,808	488	55,627
Africa:				
British—				
East	159	16,376		
South, Union of	1,810	204,427	1,004	112,294
Egypt	5,306	536,862	3,593	372,952
French—				
Madagascar			84	12,431
Other			(1)	60
Oceania (British):				
Australia	3,121	359,385	2,493	281,338
New Zealand	447	56,744	33	4,047
	250,781	28,766,352	253,888	29,062,466
DISTRICT				
Arizona	294	25,594	85	9,778
Buffalo	24,718	3,073,959	24,246	2,966,446
Chicago	865	110,918	1,887	224,591
Dakota	6,573	860,911	4,525	586,492
Duluth and Superior	528	68,800	853	121,777
El Paso	2	363	6	978
Florida			39	4,090
Georgia	67	7,048		
Hawaii	11	920	183	15,564
Los Angeles	453	48,246	4	1,092
Maine and New Hampshire	147	16,028	44	5,416
Maryland	84,440	9,629,481	89,098	10,304,636
Massachusetts			5	1,149
Michigan	1,123	126,654	709	90,323
Mobile	46	6,385		
Montana and Idaho			39	4,950
New Orleans	150	10,362	2,226	237,491
New York	106,714	11,869,542	108,543	11,874,332
Ohio	11,956	1,520,256	7,875	1,044,671

[1] Less than 1 ton.

Tin plate, terneplate, and taggers tin exported from the United States, 1926–27, by countries and by districts—Continued

	1926		1927	
	Long tons	Value	Long tons	Value
DISTRICT—continued				
Philadelphia	9,435	$1,045,600	8,766	$946,053
Porto Rico			(1)	173
Rochester	(1)	89	(1)	89
St. Lawrence	1,018	122,722	1,071	108,787
San Antonio	728	86,488	530	65,061
San Francisco	608	59,039	711	108,534
South Carolina	141	15,872		
Vermont	54	1,023	(1)	93
Washington	710	60,052	2,443	339,900
	250,781	28,766,352	253,888	29,062,466

[1] Less than 1 ton.

The following table shows tin plate, pig tin, and sheet-bar tin price changes since 1918 on the dates listed.

Changes in prices for tin plate at Pittsburgh, pig tin at New York, and sheet-bar tin at Pittsburgh, 1918–1927 [1]

Date	Tin plate (per base box)	Pig tin (per pound)	Sheet bars (per long ton)	Date	Tin plate (per base box)	Pig tin (per pound)	Sheet bars (per long ton)
		Cents				*Cents*	
1918: Dec. 13	$7.35	72.50	$47.00	1922: Nov. 23	$4.75	36.00	$36.50
1919:				1923:			
Mar. 21	7.00	71.50	42.00	Feb. 26	4.95	44.25	40.00
Nov. 15	7.00	54.25	42.00	Apr. 26	5.50	44.125	45.00
1920: Dec. 2	7.00	34.00	47.00	Nov. 1	5.50	41.875	42.50
1921:				1924: Nov. 25	5.50	54.375	37.00
Apr. 13	6.25	29.25	39.00	1925: Nov. 19	5.50	63.50	35.00
June 14	5.75	29.375	39.00	1926: Nov. 9	5.50	71.00	36.00
July 29	5.25	26.625	32.00	1927: Nov. 30	5.25	58.625	34.00
Nov. 3	4.75	28.00	30.00				

[1] American Metal Market, Dec. 2, 1927, p. 8.

Wales.—The exports of British tin plate in 1927 were 472,029 long tons, a monthly average of 39,300 tons. In 1913 the monthly average was 41,200 tons; in 1925, 42,600 tons; and in 1926, 31,250 tons. The year 1926 should not be taken into consideration because of the effect of the coal strike on the industry. It thus appears that for the British tin-plate manufacture the year 1927 approached that of 1913 in production. The largest buyers in 1927 were Australia, the British East Indies, and the Netherlands, taking, respectively, 53,500, 46,400, and 46,300 tons. In the early part of 1927 there was a great deal of unemployment in the tin-plate mills of southern Wales. Prices were erratic and keen competition evident. On November 8 the leading tin-plate makers met at Swansea. This meeting resulted in a trade agreement to restrict output as well as to establish a minimum price at which a base box should be sold. In order to restrict output, it was agreed that most of the mills would be closed down for a period of 3 weeks during the 13 weeks following November 28; in consequence, at least three-thirteenths of the tin-plate mill capacity was to be nonproductive for at least 3 months.[3] In 1925 the Welsh tin-plate trade attempted a stabilization scheme, but after nearly two and one-half years this proved a failure, largely on account of the underselling in the export trade. In the agreement reached in November, 1927, this difficulty was provided for by an understanding that the minimum price for export may be less than that for domestic consumption. A consulting committee was appointed with the power to permit manufacturers to quote below the domestic minimum on export business. The effect of this agreement became evident early in December, and the export sales of the Welsh tin-plate industry expanded rapidly. At the end of November there were 65 tin-plate works and 363 mills running, as compared with 63 works and 341 mills a month earlier.

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[3] Cooper, W. L., commercial attaché, Rept. 59684, Trade Notes, Nov. 22, 1927.

Tin plate and black plates exported from the United Kingdom, 1926–27, by destinations, in long tons[1]

Destination	Tin plate		Black plates	
	1926	1927	1926	1927
Argentina	12,190	18,568		
Australia	42,640	53,519		
Belgium	12,482	20,579	781	684
Brazil	10,987	21,827		
British East Indies	29,962	46,379		
Canada	25,230	27,127		
China (including Hong Kong)	19,103	11,081		
Denmark	10,852	12,597		
France	19,810	11,077	695	283
Germany	5,838	21,212	592	1,508
Italy	13,520	14,312		
Japan	15,319	15,666		
Netherland East Indies	17,963	19,137		
Netherlands	37,167	46,309		
Norway	13,282	18,639		
Portugal	12,685	18,868		
Rumania	3,084	3,930		
Spain	16,517	24,403		
United States	2,325	1,125		
Other countries	54,085	65,674	24,620	34,692
	375,041	472,029	26,688	37,167
Value f. o. b. mills[2]	$39,379,429	$48,842,251	$2,099,888	$2,713,485

[1] South Wales Journal of Commerce, Industrial Review, 1927.
[2] Converted from pounds sterling at par.

Germany.—The increased importations of pig tin into Germany may be accounted for in part by the following summary of the tin-plate industry. This summary gives the production, exports, and imports of tin plate in 1913, 1925, 1926, and 1927, shows the rapid growth of this industry, and indicates that Germany is less dependent upon importations for its tin plate than it was during the pre-war period.

German production, exports, and imports of tin plate, 1913 and 1925–1927, in metric tons

Year	Production	Exports	Imports
1913	83,051	760	42,125
1925	91,095	10,196	15,067
1926	100,394	19,830	9,047
1927	128,357	29,589	24,985

India.—The Tin Plate Co. of India has not increased its capacity, but the full output of the present plant, 36,000 tons a year, is being realized.

Italy.—According to a report by the British Department of Overseas Trade on the commercial, industrial, and economic situation the national tin-plate industry in Italy is subsidized by a protective tariff and is reported to be supplying about 70 per cent of the domestic demand. Since the exhaustion of the war-time stocks of scrap steel and iron the tin plate manufactured by Italy has greatly improved. The imports at present are largely confined to special sizes and thicknesses and to certain industries such as canned foods, etc., where a rebate on the duty is made when the goods are reexported. Whatever imports there are come chiefly from the United Kingdom and in part from the United States.[9]

Belgium.—In Belgium there are a number of manufacturers of tin containers, and the largest consumers of tin are the canners, Marie Thumas, of Louvain, and Le Soleil, of Malines, who manufacture their own cans and are turning out, respectively, 100,000 and 120,000 cans daily[10] (1½ and 1 kilogram sizes). The canning industry, and therefore the consumption of tin, in Belgium has not expanded rapidly, due largely to popular prejudice regarding the use of canned vegetables. Probably the price factor is also an important consideration.

Other countries.—Data on the 1927 production of tin plate in Russia, Spain, Japan, France, Czechoslovakia, Belgium, Norway, and Rumania are not available.

SOLDER

In 1927 the consumption of solder decreased as compared with 1926. This decrease is largely due to curtailment in the manufacture of automobiles in the United States and possibly also to the introduction of an alloy having the trade name of "Amaloy."

BABBITT

Based upon reports received by the Bureau of the Census, the consumption of babbitt in 1927 was 60,111,843 pounds, as compared with 65,934,782 pounds in 1926. The consumption is calculated from sales by manufacturers and from consumption by firms that consume their own products.

SUBSTITUTES

In a consular report covering in part developments in the German aluminum industry[11] reference is made to a newspaper report regarding the use of aluminum for food containers. It is stated that the research station of the canning industry at Braunschweig has found absolutely feasible and commercially sound the substitution of pure aluminum for tin. This at least applies to Germany, where tin has to be imported at high speculative prices. It is rumored that a factory at Lubeck has received orders for the manufacture of a certain quantity of aluminum cans. It is stated that the cost of a can of aluminum is approximately 3 pfennigs more than the cost of a tin can. It would seem that if such a substitution were feasible and should become general the aluminum can, which lends itself readily to reclamation, would be more economical from the standpoint of the recovery of metal than is the tin can, from which the recovery of tin is more difficult.

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[9] American Metal Market, Nov. 5, 1927, p. 4.

[10] Hunt, L. W., assistant commercial attaché, Brussels, Sp. Rept. 4, Aug. 1, 1927.

[11] Claiborne, H. C., American consul, Frankfort-on-the-Main, Germany, Feb. 3, 1928, Cons. Rept. 271903.

In the consumption of solder there seems to be in the immediate future a possibility of rather radical curtailment. The National Canners Association states that practically all products except meat and milk are now packed in what is called the sanitary or open-top type of can This type of container is sealed by double seaming the end on to the cans and using some form of gasket material. As a rule, what is known to the trade as "compound" is used; this consists largely of rubber. For many products a paper gasket is employed. There seems to be a difference of opinion among manufacturers regarding the type of compound that gives the best results. Some use Latex rubber, others use varying proportions of rubber, and some use no rubber at all.

The substitution of Amaloy for solder is claimed by its manufacturers, the American Machine & Foundry Co., to be replacing commercial solder in many of its uses. Amaloy is being used at the present time for coating automobile radiators; for soldering tin cans; for coating pipes, sheets, and battery fittings; as a substitute for the tin coating normally applied to copper wire that is to be insulated by a rubber covering; and for other uses. In the American Metal Market, issue of December 2, 1927, page 3, under the heading Reports Contract Placed for "Amaloy" Solder, attention is called to the receipt by the American Machine & Foundry Co. of a contract awarded by the Continental Can Co. covering the latter's Amaloy solder requirements for the next 12 months. The article states that it is understood that the alloy contains about 98½ per cent lead and 1½ per cent phosphorus and tin. Should this substitution prove commercially successful it might mean that a large part of the tin, at present utilized as solder in the automobile industry, would be liberated for other uses. The major part of the solder utilized by this industry is in the manufacture of automobile radiators. The falling off in the consumption of babbitt must be attributed in part to the decreased manufacture of automobiles in 1927. There seems little question, however, that the rapid extension of the use of ball and roller types of antifriction bearings has influence on the consumption of tin in bearing metals.

The low melting point of cadmium renders it serviceable as a substitute for tin in babbitt and bearing metals. Cadmium is not a very common metal. It is used in the preparation of alloys of low melting point and in the rustproofing of metallic surface by cadmium plating. It is found almost invariably and exclusively in zinc ores. Many of its chemical properties are similar to those of zinc. It has a very low melting point, 321° C., and is separated from zinc by distillation at a temperature of about 400° C. In the form of sulphide, cadmium has become of considerable importance as cadmium yellow in the paint and pigment industries.

The large amount of tin used in the manufacture of food containers indicates a problem that may be solved by the research of the chemical engineer. Steel containers with a coating of organic lacquer are used for certain types of packing. The interrelations of metals and inorganic substances in the field of protective coatings indicate a way by which a relatively large tonnage of tin may be liberated for other uses in the near future. Commercial preference would seem to be indicated for coatings of nonmetallic nature applied by brush or spraying as against metallic coatings ordinarily deposited by electroplating or by immersion in molten metal

The Federal German Railroad Co. is using a substitute for tin bearing metals which contains 0.73 per cent calcium, 0.04 per cent lithium, 0.58 per cent sodium, 0.2 per cent aluminum, and 98.45 per cent lead.[12]

WORLD PRODUCTION AND RESOURCES

World production of tin (tin content of ore), 1923–1927, by countries, in long tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923	1924	1925	1926	1927
Australia	3,283	3,069	3,016	2,860	2,625
Belgian Congo	986	994	1,060	1,145	864
Bolivia [a]	29,785	31,610	32,224	31,735	36,707
China [a]	7,936	6,993	8,884	6,509	6,220
England—Cornwall	1,021	1,986	2,339	2,327	2,593
India (British)	1,405	1,316	1,616	2,484	2,447
Indo-China	([b])	([b])	582	551	699
Malay States:					
Federated [a]	37,649	44,043	45,926	45,918	52,180
Unfederated [a]	1,727	2,870	2,146	1,773	1,988
Netherland East Indies	29,491	30,563	30,661	31,827	33,935
Nigeria	5,860	6,200	5,991	7,417	8,056
Portugal	([b])	([b])	559	758	695
Siam [c]	7,624	7,952	7,862	7,341	7,813
Union of South Africa	918	1,162	1,147	1,111	1,147
Other countries [d]	800	1,500	800	800	800
	128,485	140,258	144,813	144,586	158,769

[a] Exports.
[b] Less than 500 tons; included under "Other countries."
[c] Year ended Mar. 31 of year following that stated.
[d] Includes countries producing less than 500 tons.

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[12] Office of commercial attaché, Berlin, Germany, Mar. 27, 1928, No. 65780.

World trade in tin, 1926–27, in long tons[1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1926												
Shipments from:												
Straits	7, 321	6, 073	4, 207	6, 950	6, 868	6, 022	6, 774	5, 388	6, 593	6, 471	6, 160	7, 647
Australia	122	120	113	107	116	112	80	96	111	117	119	120
Banka and Billiton	770	932	1, 710	1, 629	2, 423	691	1, 030	1, 101	1, 488	1, 692	1, 828	1, 151
China	247	74	286	1, 227	223	125	72	85	76	181	220	206
Bolivia [2]	2, 208	2, 139	2, 520	2, 415	1, 212	4, 137	2, 052	1, 779	3, 204	1, 878	2, 652	2, 520
Nigeria [2]	494	603	788	594	413	516	329	761	581	648	658	687
	11, 162	9, 941	9, 624	12, 922	11, 255	11, 603	10, 337	9, 210	12, 053	10, 987	11, 637	12, 331
Deliveries to:												
United Kingdom	1, 394	1, 217	1, 346	1, 720	1, 113	1, 462	1, 584	1, 143	901	1, 383	802	825
United States of America	7, 340	6, 250	6, 835	7, 105	5, 685	6, 900	7, 630	5, 870	5, 835	5, 955	6, 140	6, 505
Continental Europe	1, 934	1, 338	1, 511	1, 503	1, 406	2, 427	1, 605	1, 143	1, 831	1, 759	1, 966	2, 038
All others	513	448	629	529	472	501	545	489	375	500	447	352
	11, 181	9, 253	10, 321	10, 857	8, 676	11, 290	11, 364	8, 645	8, 942	9, 597	9, 355	9, 720
Visible supply:												
Total—												
Shipments (loadings)	8, 460	7, 199	6, 316	9, 913	9, 630	6, 780	7, 956	6, 535	8, 268	8, 461	8, 327	9, 124
Afloat	3, 816	3, 667	3, 046	2, 109	4, 499	4, 143	1, 695	2, 823	2, 418	3, 036	3, 152	3, 032
Landing	1, 865	3, 330	2, 460	1, 220	1, 265	2, 189	2, 065	1, 560	1, 490	1, 175	1, 940	1, 529
In warehouse	2, 646	2, 043	2, 458	2, 274	2, 651	2, 719	2, 061	2, 434	2, 203	2, 169	1, 838	2, 641
	16, 787	16, 239	14, 280	15. 516	18, 045	15, 831	13, 777	13, 352	14, 379	14, 841	15, 257	16, 326
By countries—												
United Kingdom—												
Afloat—												
Straits	615	860	420	860	945	765	1, 380	605	905	605	829	894
Australia	126	103	89	90	93	65	42	58	90	137	87	92
Netherland East Indies	743	219	844	705	875	104	339	323	403	608	620	287
China	175	125	------	125	------	------	------	------	------	100	75	125
Stocks—All others	2, 215	1, 825	2, 284	2, 091	2, 177	2, 455	1, 111	2, 165	1, 814	1, 750	1, 055	1, 473
	3, 874	3, 132	3, 637	3, 871	4, 090	3, 389	2, 872	3, 151	3, 212	3, 200	2, 666	2, 871
United States of America—												
Afloat	8, 093	6, 774	6, 006	7, 251	8, 734	7, 617	5, 891	4, 982	5, 661	6, 253	6, 280	7, 686
Stocks and landings	2, 104	3, 399	2, 494	1, 354	1, 739	2, 409	3, 014	1, 829	1, 854	1, 554	2, 304	1, 909
	10, 197	10, 173	8, 500	8, 605	10, 473	10, 026	8, 905	6, 811	7, 515	7, 807	8, 584	9, 59
Continental Europe—												
Straits	1, 936	2, 098	1, 197	2, 275	1, 988	1, 837	1, 403	2, 268	2, 437	2, 057	2, 288	2, 20
Netherland East Indies	588	687	806	716	1, 494	535	596	1, 122	1, 190	1, 737	1, 300	864
Holland and all others	192	149	140	49	------	44	1	------	25	40	419	788
	2, 716	2, 934	2, 143	3, 040	3, 482	2, 416	2, 000	3, 390	3, 652	3, 834	4, 007	3, 860
Total visible supply	16, 787	16, 239	14, 280	15, 516	18, 045	15, 831	13, 777	13, 352	14, 379	14, 841	15, 257	16, 326
1927												
Shipments from:												
Straits	6, 132	4, 852	7, 627	6, 053	6, 346	7, 607	6, 886	6, 508	8, 161	6, 230	7, 174	8, 238
Australia	124	101	112	115	116	114	117	117	114	116	114	115
Banka and Billiton	1, 193	1, 509	1, 206	698	2, 057	1, 418	1, 003	701	1, 037	1, 813	1, 657	1, 285
China	193	102	110	302	127	291	100	32	32	5	11	30
Bolivia [2]	1, 977	865	3, 498	2, 834	867	3, 741	2, 775	2, 262	2, 751	2, 343	2, 646	3, 342
Nigeria [2]	680	747	908	([3])	579	584	546	641	710	332	562	733
	10, 299	8, 176	13, 461	10. 002	10, 092	13, 755	11, 427	10, 261	12, 805	10, 839	12, 164	13, 743
Deliveries to:												
United Kingdom	1, 670	796	1, 098	1, 311	1, 816	829	1, 478	830	1, 874	1, 615	1, 530	1, 688
United States of America	6, 295	5, 965	6, 545	6, 720	6, 070	5, 735	5, 950	6, 895	6, 110	6, 005	5, 665	4, 535
Continental Europe	1, 747	1, 975	1, 898	1, 538	1, 370	2, 625	1, 876	2, 009	1, 589	1, 955	2, 514	2, 461
All others	393	512	507	570	409	509	465	509	507	687	560	707
	10, 105	9, 248	10, 048	10, 139	9, 665	9, 698	9, 769	10, 243	10, 080	10, 262	10, 269	9, 391

[1] Compiled from monthly issues of Iron and Coal Trades Review except figures for April, 1927, whic are taken from various sources.

[2] Calculated metallic tin content of ore and concentrates.

[3] Data not available.

World trade in tin, 1926–27, in long tons—Continued

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1927—Continued												
Visible supply:												
Total—												
Shipments (loadings)	7, 642	6, 564	9, 055	(3)	8, 646	9, 430	8, 106	7, 358	9, 244	8, 164	8, 956	9, 668
Afloat	2, 649	3, 695	2, 467	(3)	2, 826	3, 332	4, 114	3, 191	2, 809	2, 400	2, 180	1, 956
Landing	2, 460	2, 139	1, 486	(3)	1, 165	1, 070	1, 505	1, 321	1, 035	2, 440	1, 618	1, 543
In warehouse	2, 591	1, 823	2, 433	(3)	2, 018	1, 806	1, 652	2, 617	1, 995	1, 680	1, 840	2, 566
	15, 342	14, 221	15, 441	13, 849	14, 655	15, 638	15, 377	14, 487	15, 083	14, 684	14, 594	15, 733
By countries—												
United Kingdom—												
Afloat—												
Straits	523	350	770	(3)	791	1, 225	329	575	645	1, 145	1, 807	871
Australia	80	89	77	(3)	65	86	104	104	57	66	95	88
Netherland East Indies	209	415	688	(3)	573	309	62	216	278	821	576	651
China	100	100	50	(3)	------	------	------	------	------	------	------	------
Stocks—All others	1, 127	1, 390	2, 193	(3)	1, 579	1, 357	1, 198	1, 737	1, 057	962	1, 455	2, 536
	2, 039	2, 344	3, 778	2, 780	3, 008	2, 977	1, 693	2, 632	2, 037	2, 994	3, 933	4, 146
United States of America—												
Afloat	5, 895	6, 052	7, 260	6, 537	6, 105	7, 205	7, 632	6, 774	7, 556	4, 963	4, 343	6, 869
Stocks and landings	3, 304	2, 484	1, 709	1, 704	1, 604	1, 519	1, 959	2, 201	1, 973	3, 158	2, 003	1, 573
	9, 199	8, 536	8, 969	8, 241	7, 709	8, 724	9, 591	8, 975	9, 529	8, 121	6, 346	8, 442
Continental Europe—												
Straits	2, 344	1, 763	2, 237	(3)	2, 297	2, 506	2, 809	2, 288	2, 649	2, 275	2, 984	2, 416
Netherland East Indies	1, 136	1, 490	440	(3)	1, 641	1, 431	1, 282	592	868	1, 294	1, 331	729
Holland and others	624	88	17	(3)	------	------	2	------	------	------	------	------
	4, 104	3, 341	2, 694	2, 828	3, 938	3, 937	4, 093	2, 880	3, 517	3, 569	4, 315	3, 145
Total visible supply	15, 342	14, 221	15, 441	13, 849	14, 655	15, 638	15, 377	14, 487	15, 083	14, 684	14, 594	15, 733

[3] Data not available.

FEDERATED MALAY STATES

It is of interest to note that the world's greatest source of tin is a region which does not consume the metal, the Federated and Unfederated Malay States. The Federated Malay States produced 52,180 long tons of tin in 1927, the largest annual output ever attained and an increase of 6,232 tons as compared with the production in 1926.

In the Mining Journal (London), January 14, 1928, it was estimated by W. R. H. Chappel that of the 1927 production 27,000 tons, in round numbers, was produced by registered companies and 25,000 tons by Chinese miners. During the past few years approximately 12,000 tons of the Federated Malay States output may be attributed to dredging. In the chapter on tin in Mineral Resources, 1926, the following statement was made: "So far dredges have not been installed in the Malay Peninsula rapidly enough to increase output materially." For 1927 this statement holds good only in part. The actual number of dredges at work and under construction in the eastern tin fields at the end of 1927 was as follows:

Dredges at work and under construction in eastern tin fields at end of 1927

	At work	Under construction	On order	Total
Federated Malay States [1]	70	21	23	114
Siam [2]	17	13	8	38
Burma [2]	6	3	1	10
	93	37	32	162

[1] Federated Malay States, Report on the administration of the Mines Department and on the mining industries for the year 1927.

[2] Mining Journal (London), June 9, 1928, p. 486.

During 1927 many new enterprises were floated, the total authorized capital for which was approximately £8,000,000. In addition to this sum, approximately £3,000,000 was invested in a power plant owned by the Perak Hydroelectric Power Co., to furnish power to the mining industry. From the statistical information available it appears that the increased production in Malay must be largely attributed to mining methods other than dredging. As reported by the Department of Mines of the Federated Malay States, there were 40 bucket dredges at work in the Federated Malay States at the end of 1925, 50 at the end of 1926, and 70 at the end of 1927; it is expected that 99 will be in operation at the end of 1928. Invariably when prices of tin are high there are a greater number of Chinese companies producing. Wide fluctuation in price is rapidly reflected in the mining conducted by the Chinese, as their investment in equipment is very slight. During periods of low prices of tin a large number of the coolies engaged in tin mining drift back to China, and one of the problems of the Malay producer is to obtain sufficient labor during such periods of low price. The difficulty has in part been met by the increased labor employed in the culture of rubber. With the increase in the production of tin by dredging it seems probable that in the immediate future, should tin remain at about present prices, this increased production may be partly offset by curtailed production represented by companies operated by the Chinese.

In the article to which reference has been made W. R. H. Chappel, in addressing the stockholders of Ramboutan Tin Mines (Ltd.), forecasts that the 1929 tin production of the Federated Malay States would be at least 65,000 tons. Taking into consideration the facts enumerated, this statement would appear to be optimistic. In an editorial in the Singapore Free Press of October 22, 1927, comment was made on the diversified local opinion regarding the proposed scheme for regulating the production and price of tin. Reference was made to this scheme in the introduction to this chapter. On the one hand are those interested in mining tin who are more or less optimistic toward the scheme, stating that it will insure them a continuance of high price; on the other hand are those inclined to be skeptical as to the feasibility of the whole matter. It is thought that the fixing of the price around £300 per long ton (65 cents per pound) is far too high. The article cited states that many of the mining schemes recently floated are on the general basis of a minimum price of £250. If this be true it would mean that the larger part of the recent dredging enterprises floated could not at present prices—52 cents per pound (March, 1928)—return the capital invested. It does not seem reasonable to suppose that the artificial maintenance of price should be justified on the ground that the new flotations might prove failures, due in part to the fact that many of them are to work areas which at one time or another have been abandoned because they were not amenable to profitable mining by primitive methods. As a large portion of the Malayan production comes directly from Chinese-controlled mines or Chinese leasing companies the difficulty of control of output seems apparent.

In an article in the Straits Times[13] it is suggested as a warning that any plan for fixing the price of tin too high will tend to drive consumers to exploiting substitutes. The danger of this has been illustrated well by rubber.

Another phase of the question of the policy of the Malayan Government in reference to tin, brought out by the rapid increase of dredging, is the silting problem. The damaging floods of December, 1926, have been attributed by some to the silting up of the rivers and streams due to the various forms of hydraulic mining. There has been a good deal of agitation to force the Federated Malay States to some governmental action. A discussion of the situation took place at a meeting of the legislative body of the Federated Malay States at Kuala Lumpur, the capital, in August, 1927. These discussions were reported in various papers of the Federated Malay States. In the August 10, 1927, issue of the Straits Times the proposed new rules are discussed. The introduction to these rules is as follows:

> It must be remembered that the tin industry, as now carried on, was almost entirely confined to dredging, for the purpose of winning alluvial deposits, which envisaged the presence of rivers, streams, and watercourses. Recently rules had come into force by which mining activities within a hundred yards of any road, railway, or building were prohibited, and he had reason to believe that a similar rule was contemplated with regard to streams and rivers.
>
> The result, if that rule was rigidly enforced, would involve a very serious loss to the country. Areas like the Ulo Jelei and the Ulu Perak had been entirely closed to mining, comprising areas of a thousand and two thousand square miles, respectively. Applications respecting those areas, he understood, were not being entertained by the Government.
>
> Then there were areas now known and being mined, and extensions of those not mined at present but which could shortly be dealt with, but if that rule was enforced they would be unavailable.

The question was discussed from the standpoint of the silting problem, the channeling of rivers, and the revenue at stake. In the last phase of the question it is pointed out that should the proposed legislation become a fact it would entail a loss of $3,888,000 in the acreage involved and a loss in the Government's revenue of $560,000 per annum. The Chief Secretary of the Federated Malay States,[14] in replying to this discussion on behalf of the Government, made the following statement in the August 10, 1927, issue of the Straits Times:

> The Chief Secretary, in reply, said the Government were in a very unfortunate position. Investigations of the rivers had to be gone on with slowly, to see what the effect of these operations were. It was no good working out sums in arithmetic on the one side without working out sums on the other also. To

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[13] Bruins, J. H., vice consul, Singapore, Straits Settlements, Oct. 28, 1927, Cons. Rept. 264952.

[14] Southard, A. E., American consul general, Singapore, Straits Settlements, Sept. 8, 1927. Cons. Rept. 259875.

be shot at and told that they were a prejudiced and narrow-minded lot as soon as they started was a little bit unfair. He hoped that it would be possible to get definite results of the investigations before very long.

The following table shows the fluctuation in prices of tin at Singapore during the last six months of 1927 and furnishes a comparison with the prices at New York for the same period as given on page 127.

Monthly price per picul of Straits tin in Singapore, July to December, 1927[1]

[1 picul=133⅓ pounds]

Month	Highest	Lowest	Average	Month	Highest	Lowest	Average
July	$147.25	$144.00	$145.36	October	$136.00	$131.37½	$133.22
August	149.62½	144.87½	147.10	November	135.25	127.37½	131.41
September	145.12½	134.12½	141.00	December	134.75	130.62½	132.46

[1] Monthly reports from American consulate, Singapore, Straits Settlements.

The following table shows the exports of tin from the Federated Malay States during the years 1925, 1926, and 1927, and indicates the gradual increase in production.

Tin exported from Federated Malay States, 1925–1927, by months, in long tons[1]

Month	1925	1926	1927	Month	1925	1926	1927
January	4,081	3,963	4,019	August	3,715	3,766	4,500
February	3,362	3,546	3,279	September	3,988	3,899	4,303
March	4,031	3,501	3,988	October	3,872	3,886	4,727
April	3,762	3,667	4,097	November	3,543	4,148	4,646
May	3,810	3,692	4,621	December	3,625	3,719	4,973
June	3,995	4,074	4,516				
July	4,242	4,086	4,607		[2] 46,026	[2] 45,947	[2] 52,276

[1] Official Statistics of the Malay States Information Agency.

[2] Annual figures, as published by the Mines Department, are as follows: 1925, 45,926 tons; 1926, 45,948; 1927, 52,180.

The Administration of the Mines Department in a report on the mining industry for the year 1927 reports, under the caption of "Output of Ore Per Unit Employed," 130.67 pounds of tin per head produced in 1927, as compared with 134.67 pounds per head in 1926.

The tin-smelting industries of the British Empire are more or less protected by export duty on tin ore or concentrates. In Malay there is a high export duty on tin ore or concentrates shipped to other than British ports. In the past approximately 55 per cent of the annual production of the Netherland East Indies has been refined by the Straits Trading Co. (Ltd.) (English), situated at Pulau Brani, Singapore. That this practice may at any time be discontinued, in part at least, seems probable in that the smelting plant at Tanjong Priok, Java, has recently been completed. At a semiannual meeting of the company on December 30, 1926, the net profits after depreciation and writing off of bad debts were reported as $987,442.51 (Straits dollars). This amount added to the balance of the previous account, $853,622.21, made a total of $1,841,064.72 on September 30, 1926. On this date the directors recommended: (1) A dividend of 75 cents per share for the half year on 900,000 shares, par value $10 each; (2) that $250,000 be placed on reserve; (3) that $100,000 be transferred to the company's provident fund or superannuation fund; and (4) that the balance, $816,064.72, be carried forward to a new account.

The capacity of the Straits Trading Co. (Ltd.) is said to be 60,000 tons of refined tin per annum. All values given are in Straits dollars.

In the Federated Malay area there is also operated what is known as the Eastern Smelting Co. (Ltd.). The paid-in capital is £250,000. This capital is divided into £200,000 in ordinary and £50,000 in preferred stock. At the close of the fiscal year, July 31, 1926, a dividend of 15 per cent was declared on each share of stock. The reserves at that time were £115,188. All the tin smelters in British Malay are controlled by the two companies.[15]

At the annual meeting of the company on November 16, 1927, the capital of the company was increased to £500,000. Also, there was to be an issue of 125,000 ordinary shares credited as fully paid, in the proportion of one bonus share for every two shares, whether preferred ordinary or ordinary, now held by them. The issued capital would then stand at 50,000 shares of preferred ordinary of £1 each and 325,000 shares of ordinary of £1, all fully paid, leaving unissued 125,000 shares of ordinary of £1 each.[16]

The method of smelting practiced is described in detail in an article in the Mining Journal (London), October 22, 1927, page 28, entitled "The Eastern Smelting Co." The process may be outlined as follows: Reverberatory furnaces are charged with tin ore or concentrates mixed with anthracite and limestone. The charge is held in the furnace for a period of 5 to 12 hours. The fused mass is then stirred thoroughly and the heat gradually raised. After 1 to 2 hours the charge is again stirred and the reduced tin tapped into a float from which it is ladled into the mold. The slag is run off and retained in slag piles. The slag is usually rich in tin and may be resmelted several times. The product from this smelting is a low-grade pig tin high in iron. This product is added from time to time to the original charges, thus reducing the iron content. The tin drawn from the reverberatories contains various percentages of such impurities as iron, copper, lead, antimony, arsenic, and bismuth. These impurities are removed from the tin by a process known as "liquation and boiling or poling." The impure pigs of tin are placed on a slightly inclined hearth, the furnace is brought to a temperature sufficient to allow the more easily fused metal (tin) to run off. The less easily fused impure metals remain on the hearth and are collected from time to time and refined. The fused tin is collected in an iron pot and kept in a molten state. The molten metal is poled by means of a log of green wood. The log introduced is subject to a process of dry distillation. The gases liberated come in contact with all parts of the bath, and the molten metal is exposed to the air, which in part oxidizes the impurities contained. Some of the impurities rise to the surface and are skimmed off from time to time. This operation is continued until the surface of the bath is bright and shining. A portion of the heavier impurities, such as iron and copper, settles to the bottom of the bath. The refined tin is ladled from the bath and poured into the molds. The duration of the polling depends upon the purity of tin desired.

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[15] Bruins, J. H., vice consul, Singapore, Straits Settlements, Jan. 5, 1927, Cons. Rept. 238708.

[16] Mining Magazine (London), vol. 37, No. 6, December, 1927, p. 36.

The following table shows the destination of the tin exported from British Malaya in 1926 and 1927:[17]

Tin exported from British Malaya, 1926–27, by destinations, in long tons

Destination	1926	1927	Destination	1926	1927
British possessions	3,819	4,968	United States	44,513	46,371
Countries of Europe	14,189	19,772	Other countries	1,009	1,289
Japan	1,613	1,922			
United Kingdom	11,101	9,453		76,244	83,775

UNFEDERATED MALAY STATES

The exports of tin from the Unfederated Malay States in 1927 were 1,988 long tons, as compared with 1,773 tons in 1926.

BOLIVIA

In 1927 Bolivia was the second largest exporter of tin in the world. According to the Bolivian Customs Office, the exports in 1927 were 37,296 metric tons of metallic tin, as compared with 32,244 tons in 1926, an increase of 5,052 tons. The following table shows the tonnages of tin contained in the barilla as shipped, by months, as well as the grade of concentrates or barilla.

Tin contained in concentrates exported from Bolivia in 1927, by months, and average grade of concentrates exported[1]

Month	Metric tons	Grade of concentrates (per cent of tin)	Month	Metric tons	Grade of concentrates (per cent of tin)
January-March	7,720	54.82	September	3,061	55.66
April	2,880	56.62	October	3,377	53.51
May	3,259	54.71	November	3,444	55.24
June	3,078	55.48	December	3,254	55.24
July	2,952	56.00			
August	3,358	54.00		[2] 36,383	[2] 55.128

[1] Mining Journal (London), Mar. 10, 1928, p. 200.

[2] Adjusted total for the year gives 67,104 tons of concentrates exported, with average tin content of 55.58 per cent.

The average grade of the concentrates shipped was 60.26 per cent metallic tin in 1925; 56.94 per cent in 1926; and 55.58 per cent in 1927. According to a circular issued by J. Blum, of Bolivia, the shipments[18] of tin, in terms of metal on the basis of concentrates containing 60 per cent tin, were made to the following destinations: United Kingdom, 29,974 tons; Germany, 6,300; France, 576; the United States, 10; Australia, 18; a total of 36,878 tons. This total includes 3,243 tons of slag calculated as containing 20 per cent fine tin.

In 1927, 81 per cent of the shipments were made to the United Kingdom for refining, as compared with 88 per cent in 1926 and 99 per cent in 1925. A large part of the Bolivian shipments of barilla are handled by Williams-Harvey & Co. (Ltd.). In 1927 the smelting plant of Williams-Harvey & Co. (Ltd.), situated at Bootle, Liverpool, England, was remodeled. The changes are possibly due to the decreased grades of the Bolivian concentrates as well as to the change in the physical quality as a result of the wider use of flotation for the concentration of the ores of Bolivia. A second Cottrell flue-dust separator was installed. The capacity of the plant was increased and at present is 60,000 tons of barilla a year. This smelting capacity does not include the German plant controlled by this company.

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[17] Bruins, J. H., consul, Singapore, Straits Settlements, Mar. 15, 1928, Cons. Rept. 278853.

[18] Mining Journal (London), "Bolivian Tin Shipments in 1927": Jan. 28, 1928, p. vii.

According to a statement made by the company and published in the American Metal Market of March 31, 1928, the financial operations of the company in 1927 were as follows: The pamphlet report of the Patiño Mines & Enterprises Consolidated (Inc.) for the year ended December 31, 1927, showed a net income of $4,800,071, after interest, depreciation, depletion, and Federal taxes, as compared with $4.286,085 in 1926. The output of metallic tin in 1927 was 12,182 long tons, as compared with 9,697 tons in 1926, thus showing an increase of 2,485 tons in 1927. During the year 382,161 dry metric tons of ore was mined. The average grade of the ore was 4.14 per cent of tin. After sorting there was delivered to the concentrator 300,441 dry tons containing 4.97 per cent of tin, as compared with 232,921 tons containing 5.67 per cent of tin in 1926. In addition to the tonnages enumerated, 1,505 dry metric tons of shipping grade was produced containing 63.87 per cent of tin and yielding 961.25 metric tons of refined tin. This tonnage was derived almost entirely from leasing operations. At the close of the year it was estimated that the development work for the year had added to the reserve 414,765 dry metric tons averaging 4.57 per cent tin, making a total reserve on December 31, 1927, of 1.231,091 metric tons having an average tenor of 4.74 per cent tin and containing 58,346 tons in refined tin. During the year the capacity of the concentrator was increased about 50 per cent. The total expense for the year, including development, marketing, and realization charges, but excluding depreciation and provision for the Bolivian income tax, were £1,805,899, equivalent to £148 per long ton of fine tin produced. The corresponding figure for 1926 was £158. At the board of directors' meeting a request was made of the stockholders for authorization to acquire by purchase the tin-smelting plant of Williams-Harvey & Co. (Ltd.), Bootle, Liverpool, England, "paying therefor the value that may be agreed upon, either in cash, from the reserves of the company, or through the issuance of new shares of stock. The purchase price would be fixed after examination is made of the books of accounts, buildings, and machinery, by responsible and capable auditors and professionals." One of the reasons for this resolution was set forth as follows: "Because as owner of the plant it would pay cost prices for smelting and refining; that is, the lowest possible obtainable, thus increasing the annual profits."

The Fabulosa Mines Consolidated of La Paz, incorporated in Bolivia on September 23, 1921, is a large contributor to Bolivia's output. The capital stock of the company was $5,000,000 in 1926. The company controls 6,600 acres of mineral land embracing the Carmen group of mines, the ores of which contain silver and bismuth in addition to tin.

There has been carried on in Bolivia a considerable amount of prospecting for stream tin, due, no doubt, to the dredging operations of the Guggenheim Exploration Co. near Potosi Hill. The production of tin from alluvial deposits before the Guggenheim dredge was installed was never great. The absence of water has been one of the drawbacks to this type of mining. From time to time tin has been produced from the alluvial ores on the slopes of Mount Chicote and the Rio Ayopayo, and in the hills between Oruro and Colquechaca.

During 1927 the gravel beds of the Huanuni River were being prospected for tin. Judging from the data available to the author, the original alluvial tin deposits of the detrital type, though relatively small, have been found in the near vicinity of one outcrop of tin lodes. In many cases where a concentration has formed in the valleys these beds have been enriched by the workings of mines in the immediate vicinity. This is particularly true in the Potosi-Porco district, where the gravels have been enriched with débris from the mining operations on Potosi Hill. The slopes of the hill below the mines of the Llallagua-Uncia have been worked for tin for a long time. These deposits have been enriched by the working of the lodes, and the placers so formed may constitute areas of sufficient size and grade to be amenable to dredging. It has been reported that at one locality on Huanuni 11,000,000 cubic yards, carrying 3.25 pounds of black tin to the cubic yard, has been definitely proved during the year, and that in Uncia a very promising property is being prospected. So far about 15,000.000 yards has been proved to contain 2 pounds of black tin to the yard.

In a paper recently read by Dr. Friedrich Ahlfeld before the Society of German Metal Foundry and Mining Engineers, with reference to the prospects of Bolivian tin mining, the following statement was made:

> Tin production fluctuates in the neighborhood of 32,000 tons fine tin a year. Competition between North America and English capital to acquire mines was now almost ended, the former now controlling 65 per cent of the total output. The discovery of fresh deposits was scarcely to be reckoned upon. The visible ore supplies of most of the big mines will be exhausted in from three to five years, and future development will depend on the following measures: Mass-recovery of low-grade ores with modern mechanical means to reduce costs (present costs usually exceed £200 per ton fine tin at smelter); improved methods of preparing low-grade pyritic ores, running 1 to 1½ per cent tin, which are plentiful in the south; the possibility of mining waterless alluvial at high altitudes; and the perfection of methods of utilizing complex ores. As regards the last item, the problem is being studied in Germany, and good results have already been attained as regards lead-tin ores.

A series of six articles has recently been published in the Engineering and Mining Journal on Reduction, Roasting, Leaching, and Electrolytic Treatment of Bolivian Tin Concentrates, Based on Physicochemical Studies in the Metallurgy of Tin, by C. G. Fink and C. L. Mantell. The March 17, 1928, issue concludes the series, giving a résumé of the articles that have been issued. The closing paragraph of this article is as follows:

> Smelters can handle foul Bolivian ores only with great difficulty. Without electrolytic refining it is difficult even to produce "standard" metal. Hydrogen reduction, leaching, and electrolytic precipitation offer a cheaper method, with greater ease of operation; moreover, it is capable of producing the highest grade of metal from complex and foul ores.

NETHERLAND EAST INDIES

The reported production of tin in the Netherland East Indies in 1927 was 33,935 long tons, as compared with 31,827 tons in 1926, an increase of 2,108 tons. This increase is due in the main to the larger production of Billiton as compared with 1926. For many years it has been the practice of the Netherland East Indies Government to ship to the Straits Trading Co. (Ltd.), in the form of concentrates, approximately 60 per cent of the annual tin production of this area. The refined tin derived from the concentrates is sold under the trademark of the Straits Trading Co. The Government of the Netherland East Indies has encountered from time to time a great deal of difficulty in marketing tin refined in the Netherland East Indies when it competes with Straits tin. Banka tin (trade name for the Netherland East Indies tin), according to the trade in the United States, has in the past lacked uniform purity, thus creating a prejudice which would no longer appear to be well founded. For many years the selling office of the Bureau of Mines of the Netherland East Indies has endeavored to encourage direct purchase by American manufacturers.

Another factor entering into this situation is that the price of tin in the Malayan area is set by the Straits Trading Co. (Ltd.) at Singapore. Buyers submitting bids for Banka tin at the Government sales office at Batavia have to await the daily announcement from Singapore before the day's price is established. The Netherland East Indies office seldom quotes a limit lower than that of the Straits. The completion of the Dutch smelter at Tandjong Priok near Batavia and the announcement that the N. V. Hollandsche Metallurgische Bedrijven are to establish a Dutch smelter, the location of which has not been finally determined, bring out the rather interesting probability that the Dutch may follow the lead given them by the British in placing an ad valorem export tax on tin concentrates produced in Dutch possessions shipped to other than Dutch ports.[19]

The following statement is extracted from a consular report by C. L. Hoover,[20] Batavia, Java, under date of July 16, 1927, entitled "Sales of Government Tin in Netherland East Indies":

> The sales office of the Government mines of the Netherlands East Indies has issued a statement to the effect that its sale of Banka tin during the first six months of 1927 has produced a revenue of 36,780,000 florins, approximately equivalent to $14,712,000 at the rate of exchange during that period. The budget for 1927 estimated the sales for this year at 300,000 piculs (40,845,000 pounds), at 140 florins per picul, or 42,000,000 florins ($16,800,000) for the year. As a result of the present high prices for tin the sales during the first half of the year have thus produced almost as much as was estimated for the entire year, and the entire income from the Banka mines after July will represent a budget surplus which will go far toward covering the estimated deficit of approximately 50,000,000 florins ($20,000,000) for 1928.
>
> *Prices uniformly higher in 1927.*—The so-called "Banka limits," or prices set by the Government for the tin produced in the Banka mines, have been uniformly higher during the first six months of 1927 than in the corresponding period in 1926 when the selling price was more than fifteen times the actual cost of production.

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[19] Mining Journal (London), "The tin boom encourages smelters"; Feb. 11, 1928, p. 108.

[20] Commerce Reports, Sept. 12, 1927, p. 669.

Block tin exported during 1925 and 1926.—In addition to about 17,000 tons of tin ore which is shipped to Singapore for smelting every year, the following quantities of block tin were exported from the Netherland East Indies during 1925 and 1926:

Exports of block tin from the Netherland East Indies

Country of destination	1925	1926
	Metric tons	*Metric tons*
Belgium		53
France	1, 100	1, 554
France, "for order"	106	
Germany		217
Germany, "for order"		109
Great Britain	106	1, 058
Great Britain, "for order"	4, 322	2, 872
Italy	737	349
Japan	557	504
Netherlands	1, 818	1, 899
Netherlands, "for order"	5, 575	6, 527
Singapore	16	
South America	34	6
United States	341	1, 477
Other countries	2	17
Total	14, 714	16, 642

The foregoing figures for exports to the United States in 1925 are not in agreement with the statement of imports from Java and Madura as published by the Department of Commerce. The table shows that only 751,769 pounds avoirdupois were shipped direct to the United States, while the consulate records an even smaller quantity, 735,076 pounds, and the Department of Commerce only 560,248 pounds. The discrepancy is explained by the fact that some of the shipments declared for the United States are in reality "for order" shipments, which go to European ports to be forwarded to the United States in case they are required to meet the demand there. On the other hand, the quantity of 9,262,952 pounds shown as coming from the Netherlands probably represented Banka tin.

The production at Singkep, Netherland East Indies, in the fiscal year 1926–27 was approximately 774 tons. In the fiscal year 1927–28 a new bucket dredge and a suction cutter dredge were installed, and it is predicted that there will be an increased production, making a total yearly production of approximately 1,500 tons. Singkep probably has the highest cost of production in the Netherland East Indies and this cost has steadily increased during the past 10 years. In the fiscal year 1917–18 the cost of production was £155 per ton, and in the fiscal year 1926–27 it was £184. This increased cost is attributed to the exploitation of lower grade ores.

In the island of Sumatra the mining of tin was conducted by the Stannum Co., a subsidary of the Billiton Mining Co., which is owned in part by the Netherland East Indies Government. The yearly production is estimated at 250 tons.

SIAM

Siam produced 7,813 long tons of tin in 1927, as compared with 7,341 tons in 1926, or an increase of 472 tons. During 1927 there have been installed a number of new dredges which will come into operation in 1928. It seems probable, therefore, that the production of 1928 may be greater than that of 1927. The Mining Magazine (London) of February, 1928, page 89, describes a new dredge to be installed by the Bangrin Co. This dredge embodies some of the latest ideas as to what should constitute a modern dredge. Among other innovations is the installation of 2 Anaconda classifiers, 4 roughing jigs, and 1 cleaning jig. The dredge is designed for digging at a maximum depth of 36 feet, with a capacity of 100,000 cubic yards per month. The ladder is equipped with 7½-cubic foot buckets.

In 1927 there were 17 dredges operating in Siam. The following table shows the quantity of tin ore exported from Monthon Puket to Penang by various companies in each month from May to October, 1927. The table also shows the distribution of the output of Siam and indicates the present rate of production.

Tin ore exported from Monthon Puket to Penang, May to October, 1927, by companies, in piculs[1]

[1 picul=133⅓ pounds]

Month	Eastern Smelting Co. (Ltd.)	Straits Trading Co. (Ltd.)	Chinese companies
May	4,114	846	129
June	3,670	1,036	92
July	4,243	1,408	134
August	3,701	827	73
September	3,675	1,213	144
October	4,103	1,197	86
	23,506	6,527	658

[1] Mining Journal (London), Mar. 17, 1928, p. 215.

NIGERIA

The production of tin in Nigeria was 8,056 long tons in 1927, as compared with 7,417 tons in 1926. Through the exploration work of the Royal Niger Co. it became evident in 1884 that Nigeria possessed tin resources. This company was attempting to open up the River Benue for trade purposes. It was found that the natives had for many years been obtaining tin of excellent quality by panning or calabashing the river beds in what is now known as the Bauchi Province. It was not until 1902 that it became profitable for Europeans to prospect the tin because of the resistance of the natives. The country was in an extremely unsettled condition for many years, and the British maintained a garrison at Fort Bukuru up to 1909. The production year by year has steadily increased, and in 1926 and 1927 Nigeria was the fourth largest producer in the world.

The concentrates produced average 70 per cent of metallic tin and are relatively free from deleterious impurities. Due to the high content of impurities in concentrates produced in other parts of the world, such as Bolivia, the Nigerian concentrates, from a smelting standpoint, are extremely desirable in that they may be mixed with other ores, thus reducing the impurities contained in the charge and cheapening the process.

Some of the companies paying dividends during 1927 were Koshe Tin Co. (Ltd.), 25 per cent for the year; the Naraguta Tin Mines (Ltd.), profits over 1926 increased by £5,000; the North Ropp River Tin Co. (Ltd.), 10 per cent as compared with 15 per cent for 1926; and the Ribon Valley Tinfields (Ltd.), 7½ per cent interim dividend.

CHINA

For many years China had an average yearly production of tin of about 8,000 tons. During the first six months of 1927, according to a consular report, Yunnan Tin During the Half Year Ended June 30, 1927, by J. E. Jacobs, August 10, 1927, the exports of tin amounted to 3,715 short tons as shown by the maritime customs at Mengtze, showing a decrease of 327 tons from the figures for 1926. During the latter part of 1927 there was a material decrease in production attributed to the presence of many bandit gangs in the mining district who temporarily disorganized the industry. Nevertheless, the total 1927 output was about the same as that of 1926. It has been estimated in the past that the domestic consumption of tin in China is usually 3,500 to 4,000 tons each year. Owing to the shortage of tin it was reported that about 400 tons of Straits tin had recently been imported into China.[21]

The conditions outlined would seem to show that China now possesses very little tin in the form of stocks. Tin constitutes the standard upon which the monetary system of Yunnan is based; therefore, it would seem reasonable to suppose that whoever controls the Government will be forced to produce tin. In an article entitled "Chinese Tin Position," which appeared in the American Metal Market, November 18, 1927, page 4, the following quotation is made from a communication received from Rudolf Wolff & Co.

> Comparatively little of the rough tin was made into 99 per cent tin, the bulk being used for the manufacture of Kwa Hung quality (under 96 per cent), which is employed throughout China for the manufacture of foil for joss paper; whether the demand was coincident with war raging is not clear, but it is possible that the strife in China has brought about a bigger use of joss paper. We can not imagine that manufacture of the latter will fall on account of the shrinkage in Yunnan supplies, and it will be interesting to see what tin they will use in place of the Kwa Hung. Our latest cable advices do not throw any fresh light on the situation but state that the stocks in Hongkong of Yunnan rough tin are down to 700 tons.

The production of tin in China during 1927, if judged by its exports, has decreased materially. This is due to the political unrest that has been prevalent during the past few years in the tin-producing areas and does not mean the physical exhaustion of the mines. Under the title of Ores and Industry of the Far East, by H. Foster Bain, 1927, pages 146 to 148, the author quotes, in part, as follows:

> *Tin.*—Tin is at present the most important metal produced in China from the point of view of value * * *. Over 80 per cent of the tin comes from the Kotchiu district near Mengtze in Yunnan. The remainder is from a number of small districts following a belt from southern Hunan through Kwangtung and Kwangsi into Indo-China. In southern Hunan, at the Kingwha mines the tin is alluvial[22] as also across the border at Fuchuan in Kwangsi.[23] In both districts the geology is such as to leave little doubt that the original source is in veins or pipes in the limestone, associated with a granite intrusive that underlies the belt.
>
> In the Linhsien and Linhwa districts the ore is definitely ascribed to such veins or pipes,[24] and in a general résumé of the district W. H. Wong[25] treats

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[21] American Metal Market, Jan. 12, 1928, p. 3.

[22] Brown, Gilmour E., Visiting the Hunan Tinfields: Mining Mag., vol. 13, September, 1915, pp. 141–145.

[23] Yung, M. B., Tin and Coal Deposits of the Fuchuan District, China: Trans. Am. Inst. Min. Eng., vol. 50, 1914, pp. 689–697.

[24] Wang, C. Y., The Mineral Resources of China: Tientsin Press (Ltd.), 1922, p. 26.

[25] Les Provinces Métallogéniques de Chine, pp. 39–41.

the region as a typical tin-tungsten belt related to the granite. While the vein tin is associated with fluorite and minor amounts of various sulphides, the alluvial tin is remarkably pure and is in demand at Hongkong for diluting the less pure metal from Kotchiu. The output of these mines has never been large, and the information available does not indicate that they are of first rank.

The extension of this belt into Indo-China now yields[26] about 300 tons of metallic tin per year, the ore coming from Kao Bang and being smelted locally. The Nam Paten mines in the Laotin Basin are also locally important. The Laos districts, indeed, are attracting attention and do offer possibilities though the geology is not known in detail. A large deposit is reported at Bo-Neng.

The most important tin-producing district in China is at Kotchiu near Mengtze in southeastern Yunnan. It was for many years distinctly inaccessible because of antiforeign sentiment among the local miners and smelters. It was visited, however, by a few French, British, and American engineers and in 1920 was examined for the Yunnan government by myself and party. Since then M. D. Draper, then associated with me, has been chief engineer for the principal company, the Kotchiu Tin Trading Co., which is controlled by the Provincial government. The district produces 7,000 to 9,000 tons of metallic tin per year. The supply comes from lodes in limestone. The mountains on which the mines are situated stand 4,000 to 5,000 feet above the plains, so the water level is far below the summit and the veins have been deeply oxidized. This accounts for the impression which obtained, before underground studies were made, that the ore was entirely placer. It is, in fact, residual essentially in place. In the mountains there is an important intrusive granite and the veins are of the usual tin-tangsten type, though tungsten is subordinate and has never been produced in quantity. The mineralized area is large, the veins well defined, the ore shoots persistent, and it is to be expected that production from this district will become more rather than less important. A narrow-gauge railway connects it with the main line of the Haiphong-Yunnan-fu Railway, and a modern mill and smelter were some years since built. The principal mine is now about to be opened by a vertical shaft superseding the slope up which ore has long been carried on men's backs. The workings extend to a depth of 1,500 feet.

AUSTRALIA

The production of tin in Australia in 1927 was 2,625 long tons, as compared with 2,860 tons in 1926.

The larger part of the past production of tin in Australia has come from New South Wales, Queensland, Northern Territory, and Tasmania. The high price of tin during 1927 constituted a sufficient inducement to those engaged in prospecting to turn their attention to the finding and developing of tin properties. This condition has resulted in considerable activity. Due to the more or less exhausted condition of the accessible alluvial deposits, more attention has been given to those localities in which tin is found in vein formation. In the New England mining district of New South Wales tin occurs in veins in granite. The veins are composed of coarse granular pegmatitic muscovite greisens. So far lode mining in this district has produced only a small portion of the output.[27] Tin ores occurring in pegmatites are said to be abundant in Queensland and Northern Territory.

The principal tin fields of northern Queensland are Kangaroo Hills, Herberton, Koorboorah, Gurrumbah, Stanhills, Irvinebank, Watsonville, and the country north of Mount Molloy, including Mount

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[26] Min. Res. U. S., 1925, pt. 1, p. 84, U. S. Bureau of Mines, 1926.

[27] Jones, W. R., Tin Fields of the World: 1925, p. 336.

Carbine, Mount Sturgeon, Mount Windsor, etc., the Tate River and Fossilbrook and Elizabeth Creek regions, north of Mount Surprise.[28]

One of the most successful mines in the Kangaroo Hills district is the Sardine Tin Mines N. L. The vein in which the cassiterite occurs is found in the granite. During the six months ended May 28, 1927, a profit of £3,329 was made. For the six weeks ended June 30, 1927, 276 tons of ore was treated yielding 36½ tons of black tin.[29]

Tasmania.—In 1927, according to the Mining Journal (London), January 7, 1928, page 13, a tin-mining company was formed under the name of Ringarooma Tin (Alluvial) (Ltd.). This company has taken over alluvial tin properties situated north and south of Sandy Creek, on the Ringarooma River. It is claimed by the company that it has developed more than 6,700,030 cubic yards, having a tenor of from 21.6 to 14 ounces of tin to the cubic yard.

To date the value of the tin produced in Tasmania is approximately £16,000,000. The larger part of this production has come from the mining of tin ore found in the Mount Bischoff property. This property has been a producer for many years and at one time was the largest lode mine in the world.

The management in reporting on the activities of the Mount Bischoff Tin Mining Co. (Tasmania) for the six months ended June 30, 1927, states that although prospecting has been continued on the surface no discovery of importance has been made. The old working faces [underground] have become poor and are approaching exhaustion. There are large quantities of material available, which bulk one-tenth of 1 per cent of tin, but this percentage is too low for treatment at the present price of metals. This position has occasioned a policy of active underground exploration, and a considerable amount of work has been performed with satisfactory results. In the crosscuts from the Stanhope adit, which is 125 feet below the main tunnel, the cross lode has proved to contain tin in paying quantities for a greater length than in the top levels. The east and west ends are still in good ore. The west end has been extended 139 feet, with an average width of lode of 13 inches and an average value of 2.51 per cent tin. The east end has been driven 39 feet from the crosscut. Here the lode has split into two veins. The footwall vein is small and poor. The hanging-wall vein is 10 inches wide and bulks 3.8 per cent tin. The ore occurs on the contact of the slates and porphyry. The mill crushed 32,840 tons of ore, and the calciners treated 3,812 tons of pyrite. Total output was 197 tons of tin oxide, assaying 66.25 per cent tin. The recovery of tin per ton of ore crushed was 0.39 per cent.

It has been decided to treat the tin-bearing areas of the North Valley by sluicing. A special plant has been designed. The sawmill has been constantly employed for the last four months cutting the large quantity of timber going into construction. Despite the severe winter conditions, fair progress has been made with the valley work.[30]

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[28] Chemical Engineering and Mining Review, Jan. 5, 1927, p. 133.
[29] Industrial Australian and Mining Standard, Sept. 1, 1927, p. 238.
[30] Industrial Australian and Mining Standard, Sept. 22, 1927, p. 322.

CORNWALL

The mining of tin in Cornwall is centuries old. It seems probable that the early production was from alluvial deposits. With the exhaustion of the easily accessible ores the lode mines came into production. One of the oldest and richest districts, from the standpoint of production from lode mines, is in the area embraced by St. Ives Bay on the south and bounded by a circle of hills extending from Carn Brea on the east through the Wendron, Tregoning, and Trencrom Hills to Rosewall on the west, and comprises an area of approximately 60 square miles. Tailing losses in the past have been high in treating the ores mined in this district. In many localities these tailings have been carried down into the valleys by erosion and have formed bars and placers. When the price of tin reaches the point where the tin may be recovered economically, it would seem that these areas might be dredged, just as similarly formed placers in Bolivia are being worked.

In 1927 there was an increase in production of metallic tin of approximately 11 per cent as compared with 1926. In 1927 4,321 tons of black tin were produced, as compared with 3,878 in 1926. One new mine, the Wheal Kitty, began shipments in September, 1927. A considerable amount of new capital was invested in the industry, and many of the old mines were being unwatered. The most important strike of the year was made in the Dolcoath mine, where a rich vein was discovered. The following table shows the black tin produced at the six principal mines in 1926 and 1927.

Black tin produced at the six principal mines of Cornwall, 1926–27, in long tons[1]

Mine	1926	1927	Mine	1926	1927
East Pool	1,078	974.66	Tresavean [2]	128	477.34
Geevor	575	582.00	Wheal Kitty [3]		36.00
Levant	251	381.25			
South Crofty	705	706.00		2,737	3,157.25

[1] Review of Commerce and Industries, Plymouth, Dec. 31, 1927, Cons. Rept. 269944.
[2] Began producing in September, 1926.
[3] Began producing in September, 1927.

A report of a meeting of the Tin Selection Trust (Ltd.), published in the London Times of January 20, 1928, states that this syndicate has been registered to take over the Polhigey mine. Also, it was announced that the company had purchased the whole issued capital of the Penpoll Tin Smelting Co. (Ltd.), owners and operators of a smelting plant at Bootle, near Liverpool; the plant is being remodeled and is to have a capacity of 12,000 tons a year. This action was probably taken owing to the desire to provide a means for the smelting of the product of the company's holdings, which embrace in part a large block of the Tavoy Tin Dredging Corporation (Ltd.) stock, and an interest in Associated Tin Mines of Nigeria (Ltd.) and the Tekka Taiping Co. It is of interest to note that the action taken by this company is similar to that taken by the board of directors of the Patiño Mines (Inc.) in Bolivia in 1928, as noted on page 143.

In December, 1927, the Jantar (Ltd.) was formed with a capital of £60,000. The purpose of the company is to acquire and develop the Porkellis mine at Helston. Also, in December the shareholders of the London Tin Syndicate approved an increase of £350,000 in its capital, of which amount £150,000 in £1 shares would be immediately issued at a price of £3 per share.

In an article in the Mining Journal (London), May 5, 1928, page 368, entitled "To-day's Outlook in Cornwall," the following statements are made: "We pointed out last year that we must regard Cornwall definitely as a low-grade field, and that we are unlikely to see any property worked on a substantial scale obtaining a recovery in excess of 30 pounds black tin to the ton." Mention is made in the article cited that the Patiño mines in Bolivia, the leading lode producer of tin in the world, and having an output in 1927 nearly six times as great as that of Cornwall in that year, according to the annual report of the company, rejected ore containing 1.08 per cent of metal. This rejected ore is higher in grade than anything being treated in Cornwall at present.

UNION OF SOUTH AFRICA

The production of tin concentrates in South Africa in 1927 was 1,708 tons, compared with 1,631 tons in 1926 and 1,735 tons in 1925.

Transvaal.—Tin ore in the form of cassiterite is found in the Transvaal in pipes or chimneys in the Waterberg district. According to Kynaston and Mellor[31] these chimneys are not fillings or following fissures or lines of weakness in the red granite in which they occur but are a replacement of part of the granite by a deposition of tourmaline, quartz, and cassiterite under pneumatolytic conditions. According to the authorities quoted tin ores are also found in hard quartzites, several occurrences of which were rediscovered in recent years bearing evidences that they had been worked in ancient times.

Several small mines are producing concentrates from occurrences similar to those described and also from the alluvial derived from them. A small quantity of tin is also won in Swaziland and the Cape Peninsula in alluvial derived from the gray granites of those parts.

The annual output of tin from the Union of South Africa fluctuates between 1,500 and 2,500 tons of concentrates, containing 66 per cent of metal, which are shipped principally to the Straits Settlements. It is probable that this figure will be maintained for some time to come both from present sources and from new discoveries that may be expected as the country becomes more inhabited.

The following is a list of tin-producing mines in the Transvaal:[32] Groenfontein Tin Mine (T. C. L. O.); Leeuwpoort Tin Mines (Ltd.); Mutue Fides Tin Mine; Olifants Tin Mines (Ltd.); Rooiberg Minerals Development Co. (Ltd.); Wembley Syndicate; and Zaaiplaats Tin Mining Co. (Ltd.).

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[31] Kynaston, H., and Mellor, E. T., The Geology of the Waterberg Tin Fields: Trans. Geol. Survey, Memoir No. 4, 1909.

[32] Office of trade commissioner at Johannesburg, Aug. 29, 1927.

SOUTHWEST AFRICAN TERRITORY

According to articles appearing in the South African Mining and Engineering Journal, August 20 and 27, 1927, entitled "Minerals and Mines in Southwest Africa," the known tin fields of Southwest African Territory are found in two long lines running east and west, one on either side of the Erongo Mountains. These mountains, which are embraced in a rectangle 30 miles east and west by 20 miles north and south are situated some 25 miles north of Usakos. Usakos is 85 miles by rail from the nearest seaport, Swakopmund, on Walvis Bay making the total distance 105 miles from the deposits to seaboard. The ore is found as cassiterite in pegmatites carrying as high as 20 per cent cassiterite in places. One of the largest companies operating in this field is the South West African Mines (Ltd.). This company controls about 20 square miles of mining area and has erected a plant for the treatment of the alluvial ground at Otjimboyo. South of the Erongo range going from east to west the following are the major holdings: Sandamap, Sidney, Carsei, Ebracht, and Ameib. These properties are situated along the strike of the pegmatite dikes which terminate in the east against the Erongo complex about 21 miles northeast of Usakos.

TANGANYIKA AND UGANDA

A report on the tin deposits of Tanganyika and Uganda has been made by A. D. Combe and submitted to the director of the Geological Survey of Uganda. In a bulletin issued by the Imperial Institute in May, 1927, an abstract of this report was published. According to this authority, cassiterite-bearing areas in the two countries mentioned are found in the districts of Kyerwa and Ibanda in northwestern Karagwe, and in Kikagati-Ntundu, Ruzinga-Naniankoko, and Dwawanga in southern Ankole. The article states that all the deposits of tinstone known up to the present occur in the more metamorphosed rocks of the Karagwe-Ankolian system, either along or adjacent to lines of contact with large granite intrusions. The cassiterite occurs in quartz reefs and veins, in small pegmatitic veins, in detrital and eluvial deposits, and in alluvial deposits.[33]

The areas outlined have also been described by Webb.[34] In this article a general statement is given and the history, geology, topography, and principal individual deposits of the areas are briefly discussed.

JAPAN

Occurrences of tin in Japan have been well known since ancient times. The Suzuyama mine in Satsuma is an example. According to the report, Mining in Japan, Past and Present, published by the Bureau of Mines, Department of Agriculture and Commerce, Japan, 1909, the production of tin has gradually decreased since 1891, and for 18 years prior to 1909 the yearly output fluctuated between 30,000 and 100,000 pounds. Domestic consumption has depended largely upon imports from the Straits Settlements. Tin occurs in Japan as cassiterite in veins, contact metamorphic deposits, and detrital deposits. The veins are found, as a rule, in strata of Paleozoic and Mesozoic Ages, usually in granite. For many years the Taniyama mine in Satsuma was the largest producer of tin in Japan. On the boundary between the Provinces of Hyuga and Bungo there is an extensive mineralized area containing tin. According to the authority cited, the deposits are of contact metamorphic type between Paleozoic limestone and quartzite and quartz porphyry. In these veins are found such minerals as pyrrhotite, arsenopyrite, chalcopyrite, and zincblende. It was stated in 1909 that "A narrow but very rich ore was discovered quite recently in the Akenobe mine in Tajima."

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[33] The Mining Digest, "Record of Progress in Mining, Metallurgy, and Geology": Min. Mag. (London), June, 1927.

[34] Webb, A. L. "Tin Areas of East Africa": Min. Mag. (London), August, 1927, pp. 87–91.

According to the publication The Geology and Mineral Resources of the Japanese Empire, Imperial Geological Survey of Japan, 1926, page 91, lode mining of tin in 1926 was confined to three properties—the Akenobe, Mitate, and Suzuyama mines. The occurrence of tin in the last-named property, associated with the sulphides mentioned, forms, in part at least, a parallel with the occurrence of tin in the pyrrhotite in the Sullivan mine, British Columbia, Canada.

BURMA

During the past 4 or 5 years there has been considerable activity in dredging for tin in Upper and Lower Burma. This is illustrated by the success of the Tavoy Tin Dredging Corporation (Ltd.), a corporation formed in 1923 with a capital of £250,000. In 4 years the corporation has returned in dividends more than its capital stock. The corporation is managing agent for Kampar Malaya Tin Dredging (Ltd.), Theindaw Tin Dredging Co. (Ltd.), Northern Tavoy Tin Dredging (Ltd.), Thingandon Tin Dredging Co. (Ltd.), and Tavoy Prospectors (Ltd.). In 1926 the yield of tin oxide from the operations of this corporation was 970 tons. The average yield was 1.84 pounds tin oxide per cubic yard. The net value per yard was 34.76d. and the net profit per yard was 26.60d. The net profit per ton of tin produced during 1927 was £134 17s. 6d.[35]

MEXICO

For many years Mexico has produced small quantities of tin. It seems probable that tin was known to the ancients. The occurrences are small and scattered over a rather wide area. Tin in the form of cassiterite has been found in the following States: Guanajuato, Durango, Jalisco, Sonora, San Luis Potosí, Aguascalientes, and Zacatecas. In an article in the Engineering and Mining Journal, July 23, 1927, pages 137 to 139, under the caption, Some Tin Placer Deposits of Mexico, Ernest H. S. Sampson gives the results of an investigation of some of the tin areas. In conclusion he states: "Although, in the history of tin mining in Mexico, failures have been many, they may be attributed largely, it would appear, to inadequate equipment; it is possible that in the future the dredge may write a new and more profitable chapter."

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[35] The Mining Journal (London), Oct. 22, 1927, p. 22.

RUSSIA

In the May 8, 1927, issue of Economic Life (Moscow) it was reported that the surveys of the Russian Geological Commission have discovered an exceptionally rich deposit of tin in the Mikhailovski mine, Chita.

In the American Metal Market of December 22, 1927, page 4, under the caption "Report Russian Plan to Establish Detinning Plants," a statement is made that according to Russian reports it is intended to establish detinning plants in the Urals, Ukraine, and other areas where there are quantities of tin-plate scrap available. It is affirmed that a plant capable of treating 10,000 tons of tin scrap annually is being operated by Chim-Metall. From the statement it must be assumed that the tin-plate industry of Russia may be larger than has been recorded.

SPAIN

The output of tin in Spain has for many years been practically negligible. During 1927 several companies were formed to exploit the tin lode deposits. As the larger part of the world's production of tin comes from the alluvial type of deposits, the development of any area in which the tin occurs as lodes is of interest. In the Province of Coruña near Noya the San Einx Tin Mines (Ltd.) is operating. This company owns the Phoenicia mine. It was estimated in June, 1926, that there was an ore reserve of more than 100,000 tons having an average tenor of 0.725 per cent tin oxide and 0.24 per cent wolframite.[36]

In the Daily Metal Reporter, January 25, 1928, page 4, an abstract is made of an article which appeared in the Boletin Minero, entitled "To Develop Tin Wolfram Deposits in Spain." In this article mention is made of the formation of a French company, known as the Société des Étains de Silleda, for the purpose of developing deposits of tin and wolframite in the Province of Pontevedra. The mineralized zone is probably a continuation of that found in the Noya area. In 1917 the Province of Pontevedra produced 43 tons of tin ore.

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[36] The Mining Journal (London), Oct. 22, 1927, p. 27.

MANGANESE AND MANGANIFEROUS ORES

By J. W. FURNESS[1]

STATISTICAL SUMMARY[2]

Salient figures of the manganese industry in the United States in 1927

	Long tons	Value
Domestic shipments:		
Total ore containing 35 per cent or more Mn	44, 741	$1, 151, 918
Metallurgical ore	27, 730	446, 781
Chemical ore	17, 011	705, 137
Number of producing mines:		
Total	39	----------
Metallurgical ore	36	----------
Chemical ore	3	----------
Imports for consumption:		
Manganese ore	620, 212	9, 271, 920
Ferromanganese (manganese content)	36, 400	3, 553, 465
In bonded warehouse Dec. 31, 1927:		
Manganese ore (manganese content)	183, 477	5, 043, 193
Ferromanganese (manganese content)	6, 436	811, 171

INTRODUCTION

Shipments of manganese ore from domestic mines in 1927 amounted to 44,741 long tons, compared with 46,258 tons in 1926. Shipments of ferruginous manganese and manganiferous iron ores totaled 1,458,418 tons in 1927, compared with 1,199,724 tons in 1926; excluding the large tonnage of Wisconsin ore that contained just over 5 per cent of manganese in 1927 and just under 5 per cent in 1926, the shipments in 1927 are less than those in 1926. Imports of manganese ores, including chemical ore, amounted to 622,067 long tons, a decrease of 116,000 tons from the imports of such ores in 1926, which approximated 738,000 tons. The ores in stock in bonded warehouses on December 31, 1927, contained 183,477 long tons of metallic manganese, indicating that the total stocks aggregated 367,000 tons of ore of a 50 per cent tenor, as compared with 179,500 tons of metallic manganese in 359,000 tons of ore of a 50 per cent tenor on December 31, 1926. These figures indicate a decrease in consumption. The amount of ferromanganese (manganese content) in Government warehouses was 6,436 long tons on December 31, 1927, and 6,194 tons on December 31, 1926. The decreases indicated are due mainly to the decrease in the manufacture of steel. In 1927,

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[1] The statistics in this report were prepared (unless otherwise stated) by H. M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

[2] Preliminary estimates of the (essential) principal statistical items for 1927 herein supplanted by final figures were released by the Bureau of Mines on Jan. 25, 1928.

44,935,185 long tons of steel was produced, and in 1926, 48,293,763 tons. During the year 1927 ferruginous manganese ore and manganiferous iron ore were imported from Egypt and Australia. The increased use of ores low in manganese content in the manufacture of pig iron has not, broadly speaking, affected the consumption of manganese ore or ferromanganese in the manufacture of steel. During the last few years the metallurgical improvements in the manufacture of ferromanganese are evidenced by the recovery in 1927 of 80.44 per cent of the metallic manganese contained in all ores used in the manufacture of this alloy, whereas during the years 1917 and 1918, 10 to 40 per cent of the manganese contained in the ores utilized was lost in the manufacture of ferromanganese. In 1927 the imports of ferromanganese were largely from Canada, United Kingdom, and Norway, and in 1926 from Canada and Norway. The alloy is manufactured in these countries by the electric-furnace process, and losses are probably not greater than 10 or 12 per cent. In the domestic manufacture of the alloy there has been a decided curtailment in losses during the past two or three years. Taking into account this elimination of waste, the consumption of manganese has been steadily increasing.

In 1927 there became available for consumption in the United States a new supply approximately equivalent to 755,000 tons of high-grade ore, as compared with 906,000 tons of high-grade manganese ore in 1926. Some of the outstanding features of the manganese industry in the United States in 1927 were: (1) The forming in August of the American Manganese Producers' Association; (2) the resumption of mining of ferruginous manganese ore in the Leadville district, Colorado; (3) the treatment of the rhodochrosite ores of Butte, Mont., by sintering and nodulizing; (4) the development of the Cleveland district, Idaho; (5) the importation of manganiferous iron ores and ferruginous manganese ores; and (6) the exportation of ferromanganese.

Some of the outstanding features of the manganese industry of the world were the continued high rate of production in India; the decrease in Brazilian production for the first six months, followed by an increase the latter part of the year due to modifications in export tariff policy; the increased production of the Gold Coast; the maintained production of the Nikopol deposits of the Ukraine; the high rate of production of the Tchiaturi deposits with relatively constant shipments; and the continued high rate of imports into France.

During the past few years high-grade metallurgical ore has been divided into two grades, namely, ore in which the tenor of manganese is in excess of 50 per cent, usually washed ore, and ores with a tenor of 45 to 50 per cent. The average prices per unit of metallurgical ore c. i. f. Atlantic seaboard for the year 1927 were: Caucasian washed, 38 to 40 cents; Caucasian crude, 33 cents; Chilean, 50 per cent manganese, 38 cents; Indian, 47 per cent plus manganese, 33 to 36 cents; Brazilian high-grade, 36 cents, low-grade, 44 per cent plus manganese, 33 cents; chemical ores, domestic, f. o. b. Philipsburg, 72 per cent dioxide content, $45 to $55 per ton; imported chemical ore 80 per cent plus dioxide content, $80 to $85 per ton c. i. f. Atlantic seaboard.

UNITED STATES

PRODUCTION

Manganese alloys and ore produced in the United States and imported from principal foreign sources, 1918–1927, in long tons

Year	Steel (production)[1]	Ferromanganese		Spiegeleisen		Manganese ore				
		Shipments	Imports	Shipments	Imports	Shipments[2]	Total imports	Imports from—		
								Russia	India	Brazil
1918	44,462,432	306,076	27,168	263,861	1,969	305,869	491,303	----------	29,275	345,877
1919	34,671,232	198,255	33,022	90,855	27	54,957	333,344	6,916	9,200	246,592
1920	42,132,934	276,594	59,254	103,672	5,234	94,420	[3] 599,764	18,762	71,238	421,523
1921	19,783,797	111,374	9,077	69,230	307	13,531	[3] 392,606	----------	113,730	262,468
1922	35,602,926	161,612	[4] 100,725	70,253	8,151	13,404	[4] 425,000	--------- [6] 1,642	[5] 24,250 [6] 298	[5] 234,598 [6] 40,595
1923	44,943,696	226,365	[4] 113,833	134,086	4,668	31,500	[4] 419,000	[7] 11,670	[7] 25,568	[7] 88,036
1924	37,931,939	232,821	[4] 56,588	76,179	7,433	56,515	[4] 505,000	[7] 41,097	[7] 54,566	[7] 54,938
1925	45,393,524	254,005	[4] 78,713	95,890	1,090	98,324	[4] 615,000	[7] 114,537	[7] 23,504	[7] 109,650
1926	48,293,763	330,070	[4] 59,710	82,982	8,783	46,258	[4] 738,000	[7] 122,345	[7] 30,596	[7] 130,698
1927	44,935,185	291,056	[4] 45,500	80,892	7,529	44,741	622,067	253,544	93,017	174,026

[1] According to American Iron and Steel Institute.

[2] Exclusive of small quantities of ore shipped for use in fluxing.

[3] Exclusive of 7,173 tons in 1920 and 8,748 tons in 1921 reported by Bureau of Foreign and Domestic Commerce as manganese ore. The value of this "ore" ranged from $46 to $292 a ton; consequently the Bureau of Mines believes that the figures represent imports of ferromanganese, spiegeleisen, manganese chemicals, and perhaps some chemical ore.

[4] From Sept. 22, 1922, to Dec. 31, 1926, the Bureau of Foreign and Domestic Commerce reported only the manganese content of the manganese ore and ferromanganese imported; for 1927 the bureau reported the gross weight of the ore but only the manganese content of the ferromanganese. This figure is a Bureau of Mines estimate of the gross weight of ore or alloy imported. For the figures reported by the Bureau of Foreign and Domestic Commerce, see the tables on pp. 166 and 168.

[5] Jan. 1 to Sept. 21, 1922. Figures represent gross weight of manganese ore imported.

[6] Sept. 22 to Dec. 31, 1922. Figures represent manganese content of ore imported.

[7] Figures represent manganese content of ore imported.

Manganese and manganiferous ore shipped from mines in the United States, 1918–1927, in long tons

Year	Manganese and manganiferous ores, exclusive of fluxing ore			Fluxing ore containing manganese		
	Ore containing 35 per cent of manganese or more	Ore containing 16 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese	Ore containing 35 per cent of manganese or more	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese[1]
1918	305,869	818,003	236,103	------------	98,160	18,196
1919	54,957	211,632	112,303	365	98,202	11,596
1920	94,420	357,279	279,687	------------	123,970	6,728
1921	13,531	8,439	62,670	------------	22,962	3,028
1922	13,404	344,674	251,614	2,278	27,705	1,666
1923	31,500	319,666	1,072,457	769	40,770	1,004
1924	56,515	286,470	587,026	1,833	24,972	------------
1925	98,324	267,252	1,153,268	------------	25,384	2,150
1926	46,258	364,312	835,412	------------	17,707	------------
1927	44,741	148,291	1,310,127	------------	1,029	2,161

[1] Includes ore containing less than 5 per cent of manganese, as follows: 1918, 1,684 tons; 1919, 844 tons; 1920, 1,250 tons; 1921, 998 tons; 1922, 117 tons.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1924–1927, by States

	Ore containing 35 per cent or more of manganese			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Shippers	Long tons	Value	Shippers	Long tons	Value	Shippers	Long tons	Value
1924									
Metallurgical	35	31,878	$441,014	55	286,470	$929,390	12	587,026	$1,713,943
Chemical	4	24,637	866,463						
	39	56,515	1,307,477	55	286,470	929,390	12	587,026	1,713,943
1925									
Metallurgical	38	76,173	954,799	53	267,252	915,316	11	1,153,268	2,799,403
Chemical	4	22,151	902,970						
	42	98,324	1,857,769	53	267,252	915,316	11	1,153,268	2,799,403
1926									
Metallurgical:									
Alabama	2	896	(1)	5	1,018	6,421			
Arizona	2	2,684	(1)	1	46	(1)			
Arkansas	4	2,450	64,010	12	8,195	47,428			
California	3	393	8,750						
Colorado				2	2,925	(1)			
Georgia	5	3,251	29,890	17	18,414	121,773	2	6,547	(1)
Idaho	1	800	(1)	2	351	(1)			
Massachusetts				1	(1)	(1)			
Michigan				2	107,202	(1)			
Minnesota				2	158,759	(1)	5	799,458	1,791,350
Montana	3	5,713	44,226						
Nevada	1	1,607	(1)	4	12,205	58,941			
New Mexico	1	1,966	(1)	2	52,033	(1)	1	29,407	(1)
North Carolina	1	55	(1)						
Tennessee	2	1,555	(1)	1	953	(1)			
Utah				1	(1)	(1)			
Virginia	4	1,998	40,242	2	2,135	(1)			
Washington	1	3,162	(1)						
Undistributed			192,775		76	944,866			143,031
Total metallurgical	30	26,530	379,893	54	364,312	1,179,429	8	835,412	1,934,381
Chemical:									
Idaho	1	30	848,770						
Montana	[2] 2	17,904							
Virginia	1	1,794							
Total chemical	4	19,728	848,770						
	34	46,258	1,228,663	54	364,312	1,179,429	8	835,412	1,934,381
1927									
Metallurgical:									
Alabama	2	(1)	(1)	2	(1)	(1)			
Arizona	3	3,905	41,880	1	179	754			
Arkansas	8	2,605	64,202	6	7,444	48,678			
Colorado	1	(1)	(1)	5	26,828	126,938			
Georgia	2	489	(1)	16	20,015	135,606	1	195	(1)
Idaho	1	3,181	50,900						
Massachusetts				1	(1)	(1)			
Michigan				1	14,763	(1)	1	59,976	(1)
Minnesota				1	6,276	22,272	4	934,599	2,169,779
Montana	4	10,124	158,900	1	10,332	(1)			
Nevada	3	1,357	16,976	2	3,310	(1)			
New Mexico	3	2,190	37,237	1	56,624	(1)	1	30,710	(1)
Tennessee	3	498	8,182	3	487	3,442			
Utah	1	27	(1)	4	239	(1)			
Virginia	5	2,583	48,860	3	1,029	7,500	1	177	(1)
Wisconsin							1	284,470	818,604
Undistributed		771	19,644		765	328,731			282,077
Total metallurgical	36	27,730	446,781	47	148,291	673,921	9	1,310,127	3,270,460
Chemical:									
Montana	[2] 2	16,382	705,137						
Virginia	1	629							
Total chemical	3	17,011	705,137						
	39	44,741	1,151,918	47	148,291	673,921	9	1,310,127	3,270,460

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[1] Included under "Undistributed." [2] Mills through which all ore was shipped; producers not counted.

In 1927 the mines of the United States shipped 44,741 long tons of manganese ore, valued at $1,151,918, a slight decrease compared with 46,258 tons, valued at $1,228,663, shipped in 1926. In 1927, 17,011 tons of chemical ore, valued at $705,137, was shipped, and in 1926, 19,728 tons, valued at $848,770. Thus the shipments of metallurgical ore were 1,200 tons more than and those of chemical ore about 2,700 tons less than in 1926. Of the domestic output of chemical ore in 1927 the Philipsburg area of Montana produced 96 per cent and Virginia the remainder.

In the spring of 1927 the Emma mine at Butte, Mont., shipped to a sintering plant at Twin Bridges approximately 6,400 tons of ore containing 37 per cent of manganese, from which was produced nearly 4,000 tons of concentrate containing 56.5 per cent of manganese.

MANGANESE ORE

During the 5-year period, 1923 to 1927, following the last tariff enactment affecting manganese, the domestic production of metallurgical ore was 173,371 long tons and of chemical ore (70 per cent dioxide) 103,967 tons, or a total of 277,338 tons. During this period the imports of manganese ore approximated 2,899,000 tons. The large measure of dependence of the United States upon foreign resources for its needs of manganese ore is thus evident. In the spring of 1927 a meeting devoted to the subject of manganese was held in Cleveland, under the auspices of the iron and steel committee and the Ohio section of the American Institute of Mining and Metallurgical Engineers, cooperating with sections in Illinois, Pennsylvania, and other States of the Great Lakes region. At this meeting discussion turned upon the political aspects of the world's manganese situation, the domestic manganese resources and reserves in relation to domestic consumption, manganese in the nonferrous alloys, and the importance of manganese in the steel industry. One of the results of the meeting was the formation on August 2, 1927, of the American Manganese Producers' Association, an organization of those interested in the production of domestic manganese. Its announced purpose is to further the production, beneficiation, and use of domestic manganese ore. The discussions at the meeting of this organization emphasized chiefly the opinion of most of those in attendance that the survival of the domestic manganese mining industry demands a protective tariff. It was further held that the tariff on manganese ore has much broader economic importance and strategic application than the preservation of the industry itself. The inventory of tonnages available in domestic deposits was also reviewed.

Other points requiring consideration in appraising the domestic manganese situation are: (1) Present practice requires a manganese ore free from deleterious impurities; (2) the trade demands the highest-grade material obtainable at price; (3) the size of the deposits in foreign countries and the grade of the material produced generally without beneficiation set a standard as to grade and price which has rarely been attained by domestic deposits; (4) in the United States the deposits, with the exception of those in the southeastern States and Arkansas, are distant from points of consumption, entailing a long railroad haul to market; (5) manganese ores produced in western United States, with the exception of a relatively small quantity shipped to Provo, Utah, are utilized at Birmingham, Ala.; Cleveland, Ohio; Pittsburgh, Marietta, and Sheridan, Pa.; Chicago, Ill.; and Reusens, Va. At these places domestic ores come in direct competition with those of foreign origin.

The following tables show the analyses of foreign and domestic ores, as well as the ocean freight rates, compared with freight rates on domestic ores to the major consuming centers in the United States.

Average analyses of domestic manganese ore and freight rates per long ton to points of consumption

Average analyses		Freight rate	
Arizona:			
Bisbee—			
Manganese	40–44	Birmingham, Ala	$10.19
Iron	5–10	Chicago, Ill	12.09
Silica	10–16	Los Angeles, Calif	9.40
Moisture	1.5	Pittsburgh, Pa	14.11
		Pueblo, Colo	10.70
Arkansas:			
Batesville-Cushman district—		Birmingham, Ala. (over 40 per cent Mn)	3.53
Manganese	47.6	Chicago, Ill	5.59
Iron	5.77	Cleveland, Ohio	8.72
Silica	6.79	Lebanon, Pa	13.62
Phosphorus	.24	Marietta, Pa	13.62
Alumina	2.98	Pittsburgh, Pa	9.82
		Reusens, Va	13.42
Georgia:			
Cartersville—		Birmingham, Ala	1.97
Manganese	41.5	Chicago, Ill	7.97
Iron	6.2	Cleveland, Ohio	7.79
Silica	14.0	Lebanon, Pa	6.84
Baryta	7.9	Marietta, Pa	6.84
Phosphorus	.15	Pittsburgh, Pa	8.19
		Reusens, Va	[1] 4.28
Idaho:			
Cleveland district—			
Manganese	45.5		
Insoluble	8.9	Birmingham, Ala	12.20
Sulphur	Trace.	Ironton, Utah	2.80
Zinc	Trace.	Pittsburgh, Pa	14.89
Moisture	16.5		
Montana:			
Butte—			
Beneficiated carbonates—			
Manganese	56.84	Birmingham, Ala	10.34
Iron	3.43	Chicago, Ill	7.80
Silica	8.28	Cleveland, Ohio	10.84
Phosphorus	.03	Pittsburgh, Pa	10.84
Alumina	1.00	Reusens, Va	11.74
Moisture	1.91		
Philipsburg—			
Metallurgical—			
Manganese	43.0		
Iron—Less than	2.0		
Silica	17.5		
Phosphorus	Low.		
Chemical—			
Manganese dioxide	72.15	Atlantic coast points including Reusens, Va.	12.60
Hausmannite	5.86	Birmingham, Ala. (over 41 per cent Mn)	10.90
Iron oxide	2.0	Cleveland, Ohio	11.40
Silica	10.57	Pittsburgh, Pa	11.40
Oxide of lime	2.02	San Francisco, Calif	13.50
Alumina	2.31		
Lead	.201		
Oxide of magnesia	.22		
Arsenic	.032		
Copper	.012		

[1] Plus switching charges, $3.60 per car.

Average analyses of domestic manganese ore and freight rates per long ton to points of consumption—Continued

Average analyses		Freight rate	
New Mexico:			
Little Florida Mountains—			
Manganese	45.75		
Iron	2.0		
Silica	2.5	Birmingham, Ala	$8.40
Alumina	.5	Chicago, Ill	8.40
Copper	.078	Cleveland, Ohio	10.20
Lead	.051	Pacific coast	8.40
Lime	5.5	Pittsburgh, Pa	10.20
Nickel	None.	Pueblo, Colo	2.80
Arsenic	None.	St. Louis, Mo	8.40
Phosphorus	Trace.		
Oxide of magnesia	Trace.		
Virginia:			
Southern section—			
Manganese	42.6		
Iron	1.1	Birmingham, Ala	5.40
Silica	16.57	Chicago, Ill	4.60
Alumina	.102	Cleveland, Ohio	3.46
Lime	.6	Lebanon, Pa	3.91
Oxide of magnesia	.32	Marietta, Pa	5.17
Phosphorus	.206	Pittsburgh, Pa	3.46
Sulphur	.028	Reusens, Va	2.02
Moisture	3.75		
Woodstock—			
Manganese	48		
Manganese dioxide	78–80		
Iron	2.65		
Silica	3.41		
Phosphorus	.24	Pittsburgh, Pa	4.80
Baryta	8.20		
Alumina	1.62–9.2		
Moisture	5.7		

Average analyses of foreign manganese ore and freight rates per long ton to points of consumption

Average analyses		Freight rate to port of embarkation	Ocean freight rate to Atlantic seaboard	Freight rate port of entry to point of consumption		
Brazil:				Philadelphia, Pa., to	Chicago, Ill	$4.80
Manganese	42–49	$2.50–$3.50	$4.00		Cleveland, Ohio	3.29
Iron	5.2				Lebanon, Pa	1.21
Silica	3.7				Marietta, Pa	1.21
Phosphorus	.18				Pittsburgh, Pa	2.72
Gold Coast:					Reusens, Va	4.515
Metallurgical—				Baltimore, Md., to	Chicago, Ill	4.60
Manganese	50–54	1.75	6.35		Cleveland, Ohio	3.09
Iron	2– 4				Lebanon, Pa	1.21
Silica	3– 7				Marietta, Pa	1.21
Phosphorus	0.1– 0.12				Pittsburgh, Pa	2.52
India:					Reusens, Va	4.305
Manganese	50.86	2.50– 3.00	5.00– 5.50	Newport News, Va., to	Chicago, Ill	4.60
Iron	6.3				Cleveland, Ohio	3.46
Silica	5.7				Pittsburgh, Pa	3.46
Phosphorus	.127				Reusens, Va	[1] 1.40
Moisture	.72			Gulf ports to	Birmingham, Ala.[2]	2.00
Russia (Georgia):					Chicago, Ill	4.00
Washed—						
Manganese	52–54	1.85	3.50			
Iron	1.5					
Silica	7– 9					
Phosphorus	0.14– 0.22					
Moisture	6– 8					
Unwashed—						
Manganese	48–50	1.85	3.50			
Iron	1.0					
Silica	11–14					
Phosphorus	0.15– 0.17					
Moisture	8–10					

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[1] Plus wharfage and handling, 12½ cents per long ton.

[2] Plus, in certain instances, wharfage and handling, 78.4 cents per long ton. The bulk of the movement, however, costs under $2.10 per ton.

FERRUGINOUS MANGANESE ORE

Shipments of domestic ore carrying 10 to 35 per cent manganese showed a very material decrease—from 364,312 long tons, valued at $1,179,429, in 1926 to 148,291 tons, valued at $673,921, in 1927—due in part to the falling off in production in Michigan and Minnesota, but in the main to the fact that a large part of the 1927 shipments from these States fell below 10 per cent manganese content.

MANGANIFEROUS IRON ORE

In 1927 shipments of domestic manganiferous iron ore containing 5 to 10 per cent manganese amounted to 1,310,127 long tons, valued at $3,270,460, compared with shipments of 835,412 tons, valued at $1,934,381, in 1926. The increase indicated for 1927 may in part be attributed to the increased production of Minnesota where the production was 934,599 tons as compared with 799,458 tons in 1926. The falling off of shipments of ferruginous manganese ore in Minnesota and the increase in production of manganiferous iron ore may possibly be attributed to the partial elimination of the selective methods of mining of these ores. As ores of this character are marketed at a common valuation for their combined metallic content of iron and manganese, there is no monetary advantage to the shipper to ship separately the higher grade of ferruginous manganese ores. In 1926 there were no shipments of ore from Wisconsin classed by the Bureau of Mines as manganiferous iron ore, but in 1927 the State shipped 284,470 tons of such ore. The difference is accounted for by the fact that the mines in Wisconsin producing manganiferous iron ore in 1927 produced 247,261 tons of ore containing somewhat less than 5 per cent of manganese in 1926, and this ore was classed by the bureau as iron ore; the ore produced in 1926 was used for the same purpose as the manganiferous shipments of 1927.

During the year 5,000 tons of manganiferous iron ore was shipped from Australia to Baltimore, Md. The ore contained from 8 to 9 per cent of manganese, was low in silica and high in iron, making a high total metallic content. The imports of ferruginous manganese ore from Egypt during the first 10 months of 1927 amounted to 7,280 tons. The Australian and Egyptian ores were utilized for the manufacture of ferromanganese and pig iron. The seemingly increased consumption of ferruginous manganese ore and manganiferous iron ore for the manufacture of pig iron may be attributed in the main to the growing practice of utilizing these ores for the elimination of sulphur and other deleterious impurities in the manufacture of pig. The usual practice is to raise the manganese content to about 0.5 of 1 per cent in the pig iron sold for foundry uses. This practice is followed by some companies if the pig iron is to be used for the manufacture of rail steels. There has been no curtailment in the consumption of ferromanganese and spiegeleisen due to the practice outlined.

USES

As the properties imparted to steel by manganese are becoming more widely known, there is an increased consumption of the metal in steel products. As an example, for several years a steel has been made containing from 0.3 to 0.5 per cent of carbon and from 1.25 to 1.5 per cent of manganese. Recently a steel containing 0.25 per cent of carbon and 1.4 to 1.8 per cent of manganese has appeared on the market. Amsco manganese steel containing from 11 to 13 per cent of metallic manganese and from 1.1 to 1.3 per cent of carbon and manufactured in the electric furnace is another example. The trade name refers more particularly to the castings made from the steel than to the manganese steel itself. It is the method of casting which has led to the indicated increased consumption of manganese steel. An appreciable proportion of the tires manufactured for the drive wheels of locomotives now contains the higher percentage of manganese.

A possible new use for manganese is indicated by the research work being done on the determination of the value of manganese in fertilizers. In a paper presented by Oswald Schreiner and Paul R. Dawson before the division of fertilizer chemistry at the Seventy-second meeting of the American Chemical Society, Philadelphia, Pa., September 5 to 11, 1926, the authors discussed the possibility of manganese functioning as an oxidizing agent, catalyst, or actual plant nutrient. In discussing these functions the following statement was made:

> However, sufficient evidence has been accumulated to indicate that, whatever the fundamental function of manganese as an oxidizing agent or catalyst or as an essential element like iron, there is the possibility of its exerting a profound influence on soil fertility indirectly through its effect on chemical and biological processes in the soil. Additional evidence of the almost universal presence of varying amounts of manganese in soils and plants has been forthcoming, the action of the element in stimulating the processes of nitrogen fixation and of ammonification and nitrification has been demonstrated, and a considerable volume of literature has accumulated in relation to the effects of manganese compounds in culture and field experiments.

Although manganese is widely disseminated throughout the earth's crust, there are large areas, such as the highly calcareous soils of Florida, marked by the deficiency of manganese.

IMPORTS

Manganese ore imported into the United States, 1925–1927

[General imports]

Country	1925		1926		1927		
	Manganese content (long tons)	Value	Manganese content (long tons)	Value	Ore (long tons)	Manganese content (long tons)	Value
Africa (British):							
South			6,214	$39,683			
West	31,750	$322,360	48,295	1,088,390	87,230	42,172	$478,214
Brazil	109,650	2,755,876	130,698	3,428,740	174,026	78,602	1,584,836
Canada	1,199	49,406	200	9,841	430	228	9,660
Chile	3,434	64,608	3,942	100,478	3,206	1,470	36,054
China	245	12,000					
Cuba	(1)	253,315	(1)	224,523	8,976	4,211	141,836
Germany	46	6,195	72	8,976	65	37	4,331
Hong Kong	622	22,528					
India (British)	23,504	550,871	30,596	899,161	93,017	47,863	1,185,610
Italy			2,920	76,263			
Java and Madura			285	4,159	1,527	863	42,276
Netherlands	5	637	12	1,327			
Norway			1,700	133,528			
Soviet Russia in Europe	114,537	4,101,070	122,345	5,046,176	253,544	133,159	5,000,279
United Kingdom	1,572	119,788	99	9,886	46	25	3,920
	[2] 286,564	8,258,654	[2] 347,378	11,071,131	622,067	308,630	8,487,016

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(1) The imports from Cuba are recorded as 12,745 tons of ore in 1925 and 14,112 tons in 1926; manganese content not shown. Producers of manganese ore in Cuba report that approximately 23,000 long tons of ore was exported to the United States in 1925, of which 4,500 tons was shipped late in December.

[2] Exclusive of the manganese content of Cuban ores.

FERRO-ALLOYS

PRODUCTION

From 90 to 92 per cent of all manganese ore used in the United States is used in the manufacture of steel in the form of alloys, chiefly ferromanganese and spiegeleisen. Manganese forms a portion and sometimes a base of many other alloys. Silicospiegel as well as silicomanganese is manufactured in small amounts. Some of the commercial products are: Manganese bronze, average manganese content 16 to 17 per cent; manganese German silver or silver bronze for the manufacture of bearings, valves, cocks, etc.; and manganin, containing 12 to 15 per cent manganese, used for electrical resistance. Manganese steels are utilized in the manufacture of steel plates, shapes, structural bars, open-hearth rails, spring steels, locomotive, freight, and passenger car wheels, tires and axles, armor-piercing projectiles, armor plate, etc.

Sir Robert Hadfield, in a paper prepared for the Iron and Steel Institute of England entitled "The Metal Manganese and Its Properties: Also Ores and the Production of Ferro-Manganese and Its History," May, 1927, states in describing some of the qualities of the metal:

> As with the metal, so with its alloys, and specially manganese steel, which has the peculiar qualities of being hard when it should be soft; tough when it should be brittle; brittle when it should be tough; nonmagnetic when it should be magnetic (that is, seeing there is no less than 88 to 90 per cent of iron in its composition); magnetic when it should be nonmagnetic (that is,

after heat treatment at about 600° C.); and possessing the combination of exceedingly high tenacity of 60 to 70 tons per square inch and elongation of no less than 50 to 60 per cent on a length of 8 inches. No other ferrous alloy has yet been discovered which shows such an extraordinary combination of these qualities.

Ferromanganese.—In 1927 the ratio of the domestic manufactured ferromanganese to the output of steel was larger than in any previous year. The amount of crude ore of foreign origin utilized in the manufacture of 1 ton of ferromanganese was 1.914 tons and of ore of domestic and foreign origin 2 tons.

Spiegeleisen.—The domestic production of spiegeleisen in 1927 was 100,314 long tons containing about 20,400 tons of metallic manganese, and the shipments were 80,892 tons containing about 16,500 tons of metallic manganese. In 1926 the domestic production was 74,581 tons containing 14,717 tons of metallic manganese, and the shipments were 82,982 tons containing 16,377 tons of metallic manganese.

Ferromanganese and spiegeleisen shipped from furnaces in the United States, 1919–1927

Year	Ferromanganese		Spiegeleisen	
	Long tons	Value	Long tons	Value
1919	198, 255	$27, 093, 816	90, 855	$3, 965, 754
1920	[1] 276, 594	41, 840, 696	103, 672	5, 289, 049
1921	[1] 111, 374	13, 654, 800	[2] 69, 230	2, 838, 692
1922	[1] 161, 612	10, 673, 638	70, 253	2, 162, 836
1923	226, 365	23, 853, 313	134, 086	4, 547, 113
1924	[1] 232, 821	23, 533, 668	76, 179	2, 354, 731
1925	[1] 254, 005	26, 006, 439	95, 890	2, 407, 226
1926	330, 070	31, 711, 871	82, 982	2, 016, 088
1927	291, 056	27, 243, 489	80, 892	1, 986, 188

[1] Includes a small quantity of silicomanganese.

[2] Includes a small quantity of silicospiegel.

IMPORTS AND EXPORTS

During 1927 the imports of ferromanganese for consumption contained 36,400 long tons of metallic manganese as compared with 47,768 tons in 1926. In 1926 the only countries, broadly speaking, able to ship ferromanganese into the United States were Canada and Norway, and in 1927, Canada, United Kingdom, and Norway. According to the Bureau of Foreign and Domestic Commerce the imports (general imports) of ferromanganese and other alloys in 1927 contained 34,018 long tons of actual manganese and originated as follows: Canada, 17,923 tons; United Kingdom, 8,912 tons; Norway, 6,724 tons; and other countries, 459 tons.

Since the tariff enactment of 1922, the domestic manufacture of ferromanganese has been expanding. During 1927 a small tonnage of ferromanganese was exported. The degree of dependence of the United States upon imported alloys has in the last few years been decreasing. In fact, the United States now is able to meet competition with foreign manufacturers in their home market.

Ferromanganese and spiegeleisen imported for consumption in the United States, 1919–1927

Year	Ferromanganese		Spiegeleisen	
	Long tons	Value	Long tons	Value
1919	33,022	$4,283,541	27	$1,018
1920	59,254	7,775,278	5,234	277,900
1921	9,077	888,419	307	10,472
1922 Jan. 1-Sept. 21	72,136	6,125,469	3,899	268,135
1922 Sept. 22-Dec. 31	[1] 22,871		4,252	
1923	[1] 91,066	8,357,023	4,668	165,791
1924	[1] 45,270	3,844,474	7,433	235,566
1925	[1] 62,970	6,033,147	1,090	39,841
1926	[1] 47,768	4,410,142	8,783	256,714
1927	[1] 36,400	3,553,465	7,529	220,979

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[1] Figures prior to Sept. 22, 1922, represent gross weight of the ferromanganese but since that date represent the manganese content only.

Manganese alloys imported into and made from domestic and imported ores in the United States, 1921–1927, in long tons [1]

	1921		1922		1923		1924		1925		1926		1927	
	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese
Ferromanganese:														
Imported	9, 077	7, 262	100, 725	80, 580	113, 833	91, 066	56, 588	45, 270	78, 713	62, 970	59, 710	47, 768	45, 500	36, 400
Domestic production [2]	104, 129	79, 319	150, 010	117, 836	251, 938	196, 844	211, 965	165, 776	259, 780	205, 046	318, 052	252, 066	294, 991	232, 900
From domestic ore [3]	10, 838	7, 419	2, 547	2, 017	13, 070	10, 008	7, 352	5, 600	14, 910	11, 592	13, 495	10, 541	10, 037	7, 472
From imported ore [3]	93, 291	71, 900	147, 463	115, 819	238, 868	186, 836	204, 613	160, 176	244, 870	193, 454	304, 557	241, 525	284, 954	225, 428
Total	113, 206	86, 581	250, 735	198, 416	365, 771	287, 910	268, 553	211, 046	338, 493	268, 016	377, 762	299, 834	340, 491	269, 300
Ratio (per cent) of manganese in ferromanganese of domestic origin to total manganese in ferromanganese made and imported		8. 6		1. 0		3. 5		2. 7		4. 3		3. 52		2. 77
Number of plants making ferromanganese	12		6		12		11		8		8		7	
Spiegeleisen:														
Imported	307	61	8, 151	1, 630	4, 668	934	7, 433	1, 487	1, 090	218	8, 783	1, 757	7, 529	1, 506
Domestic production [2]	56, 495	9, 462	72, 974	11, 668	129, 683	20, 410	107, 067	17, 731	65, 759	12, 491	74, 581	14, 717	100, 314	20, 400
From domestic ore [3]	48, 895	7, 975	70, 374	11, 365	126, 424	20, 026	103, 617	17, 306	65, 759	12, 491	74, 096	14, 627	97, 337	19, 834
From imported ore [3]	7, 600	1, 487	2, 600	303	3, 259	384	3, 450	425			485	90	2, 977	566
Total	56, 802	9, 523	81, 125	13, 298	134, 351	21, 344	114, 500	19, 218	66, 849	12, 709	83, 364	16, 474	107, 843	21, 906
Ratio (per cent) of manganese in spiegeleisen of domestic origin to total manganese in spiegeleisen made and imported		83. 7		85. 5		93. 8		90. 1		98. 3		88. 79		90. 54
Number of plants making spiegeleisen	6		4		7		6		2		2		5	
Total available supply of metallic manganese as alloys		96, 104		211, 714		309, 254		230, 264		280, 725		316, 308		291, 206
Percentage of available supply of manganese in—														
Ferromanganese and spiegeleisen imported		7. 6		38. 9		29. 8		20. 3		22. 5		15. 66		13. 02
Ferromanganese made from imported ore		74. 8		54. 7		60. 4		69. 6		68. 9		76. 36		77. 41
Spiegeleisen made from imported ore		1. 6		. 1		. 1		. 2				. 03		. 19
Ferromanganese made from domestic ore		7. 7		. 9		3. 2		2. 4		4. 1		3. 33		2. 57
Spiegeleisen made from domestic ore		8. 3		5. 4		3. 5		7. 5		4. 5		4. 62		6. 81
Ferromanganese and spiegeleisen made from domestic ore		16. 0		6. 3		9. 7		9. 9		8. 6		7. 95		9. 38
Spiegeleisen made and imported		9. 9		6. 3		6. 9		8. 3		4. 5		5. 21		7. 52
Total open-hearth and Bessemer steel	19, 605, 740		35, 228, 281		44, 383, 745		37, 476, 940		44, 758, 450		47, 626, 547		44, 260, 062	

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[1] Table prepared by H. W. Davis, of the Bureau of Mines.

[2] Quantity made.

[3] Partly estimated.

The table following shows the production and imports of ferromanganese and manganese ore during the last six years and the duties collected on the imported material:

Ferromanganese and manganese ore produced in and imported into the United States under the tariff act of 1922, in long tons

Year	Ferromanganese			Manganese ore		
	Domestic shipments	Imports	Duty collected	Domestic shipments	Imports	Duty collected
1922	161, 612	[1] 100, 725	[2] $962, 037. 45	13, 404	[1] 425, 000	[2] $405, 977. 60
1923	226, 365	[1] 113, 833	3, 834, 392. 70	31, 500	[1] 419, 000	1, 659, 638. 40
1924	232, 821	[1] 56, 588	1, 905, 643. 65	56, 515	[1] 505, 000	4, 780, 832. 00
1925	254, 005	[1] 78, 713	2, 652, 841. 80	98, 324	[1] 615, 000	6, 078, 352. 00
1926	330, 070	[1] 59, 710	1, 822, 746. 00	46, 258	[1] 738, 000	7, 935, 729. 60
1927	291, 056	[1] 45, 500	1, 526, 508. 60	44, 741	622, 067	6, 723, 964. 80

[1] From Sept. 22, 1922, to Dec. 31, 1926, the Bureau of Foreign and Domestic Commerce reported only the manganese content of ferromanganese and manganese ore imported; for 1927 the bureau reported the gross weight of the ore but only the manganese content of the ferromanganese. This figure is a Bureau of Mines estimate of the gross weight of ore or alloy imported.

[2] Tariff became effective Sept. 22, 1922; shipments and imports cover entire year.

PRICES

The wide fluctuation in prices of ferromanganese during the year may be largely attributed to the readjustment of the world's market caused by the new position attained by the United States—its needs in this alloy are being more largely supplied by domestic manufacturers, whereas in the past a large part of the domestic needs was satisfied by imports. During 1927 the monthly average price ranged from $94.79 to $104.79. In the latter part of the year the price was seemingly stabilized at $104.79 per ton. From the trend of prices and imports during the year it seems fair to assume that the present price of ferromanganese is one which to a large extent will exclude the importations of ferromanganese from Great Britain and Germany. Norway and Canada have the advantage of cheap hydroelectric power.

In Great Britain, during the latter part of the year, there was no improvement in the ferromanganese market. The price was for many months £13 sterling for domestic consumption and £11 10s. to £12 f. o. b. for export. The prices in Germany have corresponded to those of Great Britain. It was reported that the Sauda plant of the Electro Metallurgical Co., in Norway, during the summer offered ferromanganese for sale in competition with the English and German production in Europe.

Prices per long ton of ferromanganese, spiegeleisen, and manganese ore in the United States, 1922–1927 [1]

Month	Ferromanganese (80 per cent) (delivered at Pittsburgh) [2]					
	1922	1923	1924	1925	1926	1927
January	$61.90	$109.79	$113.79	$116.79	$119.79	$104.79
February	65.32	112.29	112.29	119.79	119.79	104.79
March	67.82	120.79	112.29	119.79	102.29	104.79
April	69.07	124.79	112.29	119.79	92.79	104.79
May	72.32	129.79	112.29	119.79	92.79	98.54
June	72.82	129.79	112.29	119.79	92.79	94.79
July	72.29	122.29	110.79	119.79	92.79	94.79
August	72.29	122.29	98.79	119.79	92.79	94.79
September	80.59	114.79	97.79	119.79	92.79	94.79
October	105.47	112.79	104.79	119.79	99.79	94.79
November	104.92	113.79	107.29	119.79	104.79	94.79
December	104.92	113.79	109.79	119.79	104.79	104.79

Month	Spiegeleisen (20 per cent) (at producers' furnaces)					
	1922	1923	1924	1925	1926	1927
January	$25.50	$34.90	$39.00	$32.00	$34.00	$37.00
February	28.00	35.75	39.00	33.00	34.00	37.00
March	28.00	37.25	38.00	33.00	34.00	37.00
April	30.00	39.25	36.00	33.00	34.00	37.00
May	30.00	43.00	36.75	33.00	34.00	35.50
June	35.25	46.00	36.00	32.00	34.00	34.80
July	35.00	45.00	35.00	31.50	34.00	34.00
August	37.00	45.00	32.50	32.25	34.00	33.35
September	38.00	43.50	32.00	33.00	34.00	33.00
October	37.75	40.00	31.00	33.00	34.00	30.15
November	36.80	39.00	31.75	34.00	38.75	30.00
December	35.50	38.00	31.00	34.00	37.00	31.00

Month	Manganese ore (50 per cent) [3]					
	1922	1923	1924	1925	1926	1927
January	$10.50	$29.45	$31.20	$32.20	$30.70	$30.70
February	11.00	29.45	32.70	32.70	30.70	30.70
March	12.50	31.70	32.20	33.20	30.70	30.70
April	12.75	33.20	32.20	33.20	30.70	30.70
May	12.75	32.70	32.20	32.70	30.70	30.70
June	13.25	32.95	31.70	32.20	30.70	30.70
July	13.50	32.95	30.70	32.20	30.70	30.70
August	13.75	32.95	30.20	32.20	30.70	30.70
September	14.35	31.70	30.20	31.70	30.70	30.70
October	25.50	31.70	30.20	31.70	30.70	30.70
November	25.50	31.70	31.70	31.70	30.70	30.70
December	25.50	31.70	32.20	31.70	30.70	30.70

[1] Iron Trade Review.

[2] Beginning with Sept. 22, 1922, a duty of 1⅞ cents a pound of contained manganese was placed on ferromanganese imports.

[3] Beginning with Sept. 22, 1922, a duty of 1 cent a pound was placed on the metallic content of imported manganese ore. This amounts to $11.20 a ton on 50 per cent ore.

CONSUMPTION OF ORE IN ALLOYS

The table following shows that Brazil and Russia furnished approximately 76 per cent of the 564,725 long tons of imported manganese ore utilized in the manufacture of ferromanganese in 1927; of the ore from Brazil 99 per cent had a tenor of 43.393 per cent manganese (natural basis), and of that from Russia 99 per cent had a tenor of 49.282 per cent (natural basis). In addition to the imported ore used in ferromanganese 1,640 tons were used in the manufacture of spiegeleisen, 469 tons in making pig iron, and some in making silicomanganese and silicospiegeleisen. The total imports of manganese ore in 1927 amounted to 622,067 tons. The difference between the stocks of ore in Government warehouse on December 31, 1926, and December 31, 1927, was an increase of approximately 8,000 tons.

Foreign manganese ore used in manufacture of ferromanganese in the United States, 1925–1927, in long tons[1]

Source of ore	1925	1926	1927
Africa	33, 582	42, 692	41, 470
Brazil	207, 238	237, 358	245, 485
Chile	2, 062	5, 653	3, 746
China	606	------------	------------
Cuba	10, 543	18, 372	9, 408
India	68, 326	31, 667	78, 548
Porto Rico	2, 776	1, 202	1, 666
Russia	194, 006	282, 954	184, 402
	519, 139	619, 898	564, 725

[1] Table compiled by H. W. Davis, of the Bureau of Mines.

SILICOMANGANESE AND SILICOSPIEGEL

The following description of these alloys has been prepared by C. H. Herty, jr., and B. M. Larsen, of the Bureau of Mines:

> In regard to the physical qualities imparted to steel by these alloys [silicomanganese and silicospiegel], it is generally believed that if a heat is "reboiled" a good many of the nonmetallic inclusions which may exist in the steel are cleaned out. This reboiling is usually done with 10 or 15 per cent ferrosilicon or straight spiegel, and it is possible that silicomanganese or silicospiegel would work just as well or even better than the three mentioned above. However, there is absolutely no definite information on this point, nor is it probable that any information is obtainable as to the physical qualities of the finished steel. The only thing that can be said about replacing ferrosilicon and ferromanganese with silicomanganese is that it is possible to make high-manganese, low-carbon steels with this alloy, whereas such steel can not be made with commercial high-carbon ferromanganese and ferrosilicon. On the other hand, low-carbon ferromanganese is on the market and is being used to a considerable extent in making high-manganese, low-carbon steels.
>
> Silicomanganese steels, usually containing 0.8 to 1 per cent of manganese and 1.5 to 2 per cent of silicon, have been used for some time for special purposes. These steels seem to be essentially characterized by high yield point but do not give exceptional values for toughness and ductility. About the only well-established use for silicomanganese steel is in making automobile and railway springs. The class of steels called low-carbon manganese steels (in the manufacture of which silicomanganese or low-carbon ferromanganese alloys are used) is just beginning to be commercially developed, and the field of usefulness of these steels is not yet very well defined. They have been used in special steel castings where a tough machinable casting is needed with a somewhat higher yield point and tensile strength than ordinary low-carbon steels. Such steels are also being sold as case carburizing steels and are used in making track bolts and for similar uses that require a tough, strong steel having qualities of machinability comparable to those in Bessemer screw stock. Such low-carbonmanganese steels have good machining qualities with higher strength and yield point than other easily machined steels, and may possibly show appreciably higher strength at higher temperatures. Since the added cost of making these steels as compared to ordinary low-

carbon steels is perhaps smaller than that for any other class of alloy steels, their field of usefulness may be widened in the near future, but no very definite list of applications of these steels can be given now.

If a heat is reboiled with silicomanganese or silicospiegel, the alloy in fairly large lumps is thrown into the furnace during the working of the heat, or such lumps may be added in the furnace just before tapping or in the ladle.

There appears to be no way of getting quantitative figures on the proportion of steel produced with these alloys to that produced with ferro-alloys, but it is safe to say that the former is fairly small by comparison.

Silicomanganese is made in an electric furnace by the reduction of either a mixture of silica rock and manganese ore or of manganese silicate ore with carbon. The furnace generally used is an ordinary open-top pit furnace with a carbon bottom. The charge, containing a mixture of coke or charcoal and the ores, and sometimes iron ore and lime, is fed into the top of the furnace and smelted down by the heat from the smothered arc used. It is tapped when a sufficient quantity of the reduced metal has accumulated in the hearth of the furnace. Silicospiegel can be easily made in an electric furnace by a process similar to that used for manufacturing silicomanganese alloys. The power consumption, however, is much lower on account of the smaller formation of metals difficult to reduce. Silicospiegel may also be made in a blast furnace, the process being quite similar to that used for manufacturing blast-furnace ferrosilicon. There are some indications that the manganese silicate ores are reduced with greater difficulty than manganese ore and silica rock and that the power consumption is usually somewhat higher. Both types of charge, however, have been and probably are now being used for the production of silicomanganese alloys.

As indicated in the preceding paragraph, either manganese ores or manganese silicate ores may be used in making these alloys. Iron turnings, iron ore, or roasted pyrites may be used to add iron to the charge if necessary. Various fluxes such as lime and fluorspar may be added to the charge to form slag. If the manganese ore does not supply enough silica, quartz rock or quartzite is added to the charge.

Silicomanganese may be obtained in a number of grades. The analysis of the grade most commonly used is as follows: Mn, 60 to 70 per cent; Si, 18 to 25 per cent; C, 0.43 to 1.25 per cent; Fe, 8 to 12 per cent. The analysis of silicospiegel varies as follows: Mn, 17 to 22 per cent; Si, 6 to 12 per cent; C, about 1 per cent. A typical analysis of silicospiegel is Mn, 20.32 per cent; Si, 10.33 per cent; C, 1.26 per cent; P, 0.07 per cent.

In making high-manganese low-carbon steels "low-carbon ferromanganese" is used extensively. Its analysis is Mn, 80 to 85 per cent; Si, 0.25 per cent; C, 0.4 to 0.7 per cent; Fe, 12 to 16 per cent.

Among the manufacturers of these alloys are the Electro Metallurgical Co., New York, N. Y.; Vanadium Corporation of America, New York, N. Y.; and Jackson Iron & Steel Co., Jackson, Ohio.

The Electro Metallurgical Sales Corporation announces the 1928 price on silicomanganese as $145 per long ton.[3]

MANGANIFEROUS ZINC RESIDUUM

Manganiferous residuum, from zinc roasting in the United States, shipped in 1920–1927, in long tons

1920	133,602	1924	119,457
1921	12,627	1925	147,937
1922	81,333	1926	179,926
1923	132,801	1927	(4)

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[3] American Metal Market, Dec. 2, 1927, p. 1.
[4] Bureau of Mines not at liberty to publish figures.

MANGANIFEROUS SILVER ORE

Manganiferous silver ore shipped from mines in the United States, 1918–1927, in long tons [1]

Year	Arizona	Colorado		Montana	Nevada	New Mexico
		For fluxing	For other purposes			
1918	10,854	24,931	99,110	----------	80,096	475
1919	1,964	29,769	11,055	----------	77,815	250
1920	345	34,670	11,056	----------	95,142	541
1921	----------	10,819	924	----------	14,871	300
1922	----------	13,951	----------	6,656	----------	8,764
1923	----------	10,376	18,348	3,596	28,571	----------
1924	----------	4,488	30,949	5,607	16,710	----------
1925	----------	11,366	7,352	----------	16,168	----------
1926	----------	6,656	2,925	----------	11,051	----------
1927	----------	1,029	26,828	----------	2,161	----------

[1] All used for fluxing except that from Colorado designated "For other purposes."

FERRUGINOUS MANGANESE AND MANGANIFEROUS IRON ORES UTILIZED IN MANUFACTURE OF MANGANESE PIG

The use of manganese ores having a relatively small manganese content has greatly increased. The shipments of ore containing 5 to 10 per cent of manganese amounted to 1,310,127 long tons in 1927, valued at $3,270,460, as compared with 835,412 tons in 1926, valued at $1,934,381. Iron ores containing 2 per cent or more but less than 5 per cent of manganese were produced chiefly in Michigan, Minnesota, and Wisconsin. Shipments from these States in 1927 amounted to about 1,102,400 tons. During the year there were relatively large tonnages of manganiferous iron ore (tenor less than 2 per cent) mined and shipped. Figures as to the amounts are not available.

The growing tendency on the part of the manufacturers of pig iron to utilize in the blast furnaces ores containing more than 3 per cent of manganese but less than 5 per cent has enabled the miner to separate this grade from the iron ores produced and to obtain a slightly higher price than that commanded by iron ores. In the United States iron ores containing the percentages of manganese mentioned are largely produced in the Lake Superior region from the Mesabi, Menominee, Gogebic, and Cuyuna ranges. The following figures were published in the Transactions of the American Institute of Mining and Metallurgical Engineers, No. 1664–C, page 4, April, 1927, Reserves of Lake Superior Manganiferous Iron Ores, by Carl Zapffe:

Lake Superior ore shipped, 1902–1926

Year	All grades of ore (long tons)	Manganiferous ore	
		Long tons	Percentage of total ore
1902	26,777,101	269,131	1.0
1903	23,729,950	335,810	1.4
1904	21,435,988	145,195	.7
1905	33,675,404	264,573	.7
1906	37,600,858	717,049	1.9
1907	40,229,789	651,468	1.6
1908	25,744,084	264,884	1.0
1909	41,959,668	716,310	1.7
1910	42,366,180	650,491	1.5
1911	31,501,183	450,127	1.4
1912	45,863,223	827,154	1.8
1913	47,906,332	882,144	1.8
1914	31,434,096	622,290	1.9
1915	45,883,488	881,020	1.8
1916	65,191,903	1,794,325	2.8
1917	62,521,465	1,621,305	2.6
1918	61,972,871	2,613,135	4.2
1919	46,666,878	1,732,300	3.7
1920	57,938,428	2,377,560	4.1
1921	22,523,989	230,726	1.0
1922	43,431,294	1,592,266	3.7
1923	60,024,176	2,441,586	4.1
1924	43,276,165	1,438,241	3.3
1925	54,784,355	2,247,472	4.1
1926	[1] 60,000,000	[1] 2,500,000	4.2
	1,074,438,868	28,266,562	[2] 2.63

[1] Approximate (vessel and rail) and subject to correction.

[2] Average for the period 1902 to 1917, inclusive, is only 1.6 per cent; average for the period 1918 to 1926, inclusive, is 3.6 per cent.

CUYUNA RANGE SHIPMENTS

Ferruginous manganese and manganiferous iron ore shipped from the Cuyuna district, Minnesota, 1919–1927, in long tons

Mine	Ore containing 10 to 35 per cent of manganese								
	1919	1920	1921	1922	1923	1924	1925	1926	1927
Algoma (Hoch)	24,478	[1] 5,115	--------	--------	--------	--------	--------	--------	--------
Arko	500	2,044	--------	--------	--------	--------	--------	--------	--------
Cuyuna Mille Lacs (Louise)	--------	--------	--------	--------	--------	12,337	15,896	158,611	6,276
Ferro	14,556	--------	--------	--------	--------	--------	--------	--------	--------
Gloria	2,637	738	--------	--------	--------	--------	--------	--------	--------
Hillcrest	--------	--------	--------	--------	430	--------	--------	--------	--------
Hopkins	5,849	--------	--------	--------	--------	6,190	19,929	--------	--------
Joan, Nos. 1 and 4	--------	8,500	--------	--------	--------	--------	--------	--------	--------
Mahnomen	11,472	9,842	--------	69,644	74,247	119,781	41,840	--------	--------
Mangan Nos. 1 and 2	92	10,979	--------	--------	--------	--------	--------	--------	--------
Merritt Nos. 1 and 2	--------	33,239	--------	--------	[2] 24,387	--------	--------	[3] 148	--------
Milford (Ida Mae)	--------	[1] 20,851	--------	--------	--------	--------	--------	--------	--------
Portsmouth	--------	--------	--------	38,000	--------	--------	--------	--------	--------
Sagamore	79,248	163,904	--------	197,449	154,570	21,607	--------	--------	--------
Sultana	120	[1] 38,312	--------	--------	--------	--------	--------	--------	--------
	138,952	293,524	--------	305,093	253,634	159,915	77,665	158,759	6,276

Mine	Ore containing 5 to 10 per cent of manganese								
	1919	1920	1921	1922	1923	1924	1925	1926	1927
Cuyuna Mille Lacs (Louise)	--------	--------	--------	--------	--------	9,737	165,142	[4] 12,046	218,791
Evergreen	--------	--------	--------	--------	--------	--------	--------	6,054	--------
Hillcrest	--------	--------	15,473	4,100	--------	--------	--------	--------	--------
Kennedy	--------	9,511	--------	--------	--------	--------	--------	--------	--------
Mahnomen-Sultana-Hopkins [5]	90,896	81,066	41,057	110,590	282,883	128,967	206,155	384,753	374,307
Milford (Ida Mae)	--------	--------	--------	870	77,300	--------	205,050	202,154	149,034
Portsmouth	--------	158,336	--------	133,000	138,998	--------	--------	--------	--------
Sagamore	7,324	--------	--------	--------	--------	222,823	165,062	194,451	192,467
	98,220	248,913	56,530	248,560	499,181	361,527	741,409	799,458	934,599

[1] According to the Iron Trade Review.

[2] According to the Lake Superior Iron Ore Association.

[3] According to Skillings Mining Review.

[4] Includes sinter.

[5] Mahnomen prior to 1926.

CHEMICAL ORES

PRODUCTION

The shipments of chemical ore from domestic mines in 1927 were 17,011 long tons, valued at $705,137, as compared with 19,728 tons, valued at $848,770, in 1926. The 1927 average price of imported chemical ore, powdered, coarse or fine, 80 to 82 per cent MnO_2, was $70 to $80 a ton c. i. f. Atlantic seaboard. The average price of domestic ore, 70 to 72 per cent dioxide, was $40 to $50 a ton.

By far the larger part of the chemical grade of manganese ore is consumed in the manufacture of dry batteries. This industry was started about 38 years ago, the batteries manufactured at that time being sufficient to take care of the needs of the telephone service. Later the internal-combustion engine created a demand for a reliable source of current for ignition. For a short time the rate of consumption was curtailed by the storage battery, but was later greatly augmented by the radio industry. During the last two years this use had been in part supplanted by the light-socket power for radio. The threatened curtailment in consumption of manganese dioxide by this invention has been more than offset by the increased demand for miniature batteries in the flash-light trade. The principal sources of the ores utilized in the domestic manufacture of dry cells are Philipsburg, Mont., Caucasus, Russia, Cuba, Gold Coast, Porto Rico, and Java.

During the war period, 1917–18, in the United States the following counties in various States produced chemical ore purported to contain enough dioxide to constitute chemical grade:

Counties in which dioxide ore containing a high percentage of pyrolusite was produced during the war period, 1917–18

State	County	State	County
Arizona	Cochise and Maricopa.	Oregon	Jackson.
California	Alameda, Imperial, Mendocino, Riverside, San Bernardino, San Joaquin, and San Luis Obispo.	South Dakota	Lawrence.
		Tennessee	Johnson.
		Utah	Emery, Eureka, Grand, Juab, and Tooele.
Montana	Granite.	Virginia	Bland, Page, and Shenandoah.
Nevada	Clark, Lincoln, and White Pine.		

For a time there was an attempt to use artificial dioxide. This innovation, however, did not prove practical. The domestic ores, especially those of Philipsburg, are considered by the trade the most desirable, in that they excel in the following qualities—porosity, depolarizing ability, and cheapness.

In 1923, according to the United States Bureau of the Census, the number of dry cells manufactured was 221,859,834, valued at $18,903,269, and in 1925, 530,997,016, valued at $37,238,607, illustrating the rapid growth of this industry.

Chemical manganese ore shipped from mines in the United States, 1919–1927, by States

Year	California		Idaho		Montana		Virginia		Total	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1919	179	(1)			19, 896	(1)			20, 075	$797, 163
1920					14, 809	(1)	18	(1)	14, 827	539, 543
1921					11, 129	$444, 981	102	$3, 000	11, 231	447, 981
1922					9, 706	(1)	800	(1)	10, 506	404. 965
1923					19, 540	646, 225	900	40, 000	20, 440	686, 225
1924					23, 512	816, 463	1, 125	50, 000	24, 637	866, 463
1925					20, 529	825, 970	1, 622	77, 000	22, 151	902, 970
1926			30	(1)	17, 904	(1)	1, 794	(1)	19, 728	848, 770
1927					16, 382	(1)	629	(1)	17, 011	705, 137

[1] Bureau of Mines not at liberty to publish figures.

MANGANESE MINING, BY STATES

ALABAMA

In 1927 shipments of manganese ore and ferruginous manganese ore were made from Alabama, but the Bureau of Mines is not at liberty to publish the figures.

ARIZONA

Arizona shipped 3,905 long tons of manganese ore in 1927 and 2,684 tons in 1926. The largest production was from the Higgins mine (Twilight claim), which contains the largest body of manganese ore discovered in the Bisbee district. In the Bisbee district the ore is found in what appears to be lenticular bodies near fault fissures which give the deposits the appearance of occurring in vein formation. The deposits have been developed by open cuts or shallow shafts or inclines and have not been mined to any great depth. They are found in the Escabrosa and Martin formation of Lower Carboniferous age. The ore is principally psilomelane with smaller amounts of manganite and pyrolusite. Alabandite (manganese sulphide) occurs in small quantities on the bed or floor of one deposit. The deposits are the products of weathering. In some places angular cherty fragments or pebbles are cemented by oxide of manganese. In July, 1927, approximately 4,500 tons of 35 per cent ore was in sight at the Higgins mine, and the reserves of probable ore were estimated to be 30,000 to 35,000 tons. The reserves of the Bisbee district are estimated to be 50,000 tons of 35 per cent plus manganese. This tonnage could possibly be produced to sell at $35 per ton.

Shipments of ferruginous manganese ore from Arizona amounted to 179 tons in 1927, as compared with 46 tons in 1926.

The Higgins deposit is being mined from an open cut from which there is a drift in the ore. From this drift the ore is extracted by overhand as well as underhand stoping. The body is tabular, has a thickness of 5 to 8 feet and a dip of about 30° to the southwest, but does not follow the local bedding plane, the dip of which varies from 0 to 10° to the southwest. In July, 1927, the ore was being broken across a width of 8 feet. The bedding of the limestone is clearly visible on what is termed the hanging wall. The footwall shows a streak of alabandite a few inches wide. The ore as mined contains from 25 to 35 per cent of manganese but contains so much iron-oxide mineral that it is not possible, by sorting, to raise the grade of the product above 40 per cent. The ore is broken by means of air drills, hand sorted in the stope, shoveled into chutes, and dropped through a raise to a tunnel 200 feet below. It is then trammed to ore bins and trucked to the railway station at Bisbee. The ore is being shipped to Birmingham, Ala., and the freight rate for such a haul is $10.19 per ton.

The scale of prices for the manganese ore is as follows: 30 to 35 per cent of manganese, 46 cents per unit; 35 to 40 per cent, 50 cents; 40 to 45 per cent, 55 cents; 45 per cent, 60 cents.

The following is an average analysis of 5,855 dry tons of the manganese ore shipped from the Higgins property during 1926 and 1927: Mn, 40.35 per cent; SiO_2, 12.39 per cent; Fe, 10.32 per cent; H_2O, 3.49 per cent; P, 0.035 per cent.

ARKANSAS

In 1927 Arkansas shipped 2,605 long tons of ore, containing 35 per cent or more of manganese, as compared with 2,450 tons of ore carrying 48 per cent or more of manganese in 1926. The shipments of ferruginous manganese ore in 1927 were 7,444 tons, as compared with 8,195 tons in 1926. Practically all the ore produced in Arkansas comes from the Batesville-Cushman district. In July, 1927, three companies were operating—the Arkala Manganese Ore Co., the Miller & Rinehart Co., and the Walter Dennison operations.

The first shipments from this State were used in the manufacture of steel by Messrs. Schoenberger (Juniata) Iron Works, Pittsburgh, Pa., in 1868.[5] The total production of the State up to and including 1927 was 101,026 tons of high-grade ore and 107,961 tons of the grades of ore that are classified as ferruginous manganese ore and manganiferous iron ore. In the Batesville-Cushman district some 203 mines and prospects are recorded, from which manganese has been produced in greater or lesser quantities. During the war period, 1917–18, 17,871 tons of high-grade ore (35 per cent plus) was produced and 18,273 tons of ore (10 to 35 per cent). The total investment of capital during this period as shown by the War Minerals Relief Commission claims was $1,059,499.46.

The distribution of manganese ore in clay is irregular. In some places, though rarely, it is evenly distributed throughout a large body of clay; but in most places it is in numerous pockets surrounded by clay containing no ore. This irregular distribution is the principal cause of the uncertainty in mining.

The mining problems, known for 40 years, have not as yet been commercially solved, at least not to the point of continuous, dependable, and profitable production. The output of the Batesville-Cushman district is diminishing in spite of relatively well-sustained high prices since 1922. Broadly speaking, little progress has been made in the methods of mining the Arkansas manganese deposits. Even though steam shovels have been tried, the principal equipment is still wheelbarrow, pick, and shovel. Some progress has been made, however, in the concentration of low-grade ores.

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[5] Penrose, R. A. F., Annual Report of the Arkansas Geological Survey: Vol. 1, 1890, p. 62.

In August, 1927, mining was not as active as it was in the spring of 1923. Then work was being carried on at the Polk Southard, the Rogers, the old Aydelott (known as the Brooks property, and operated by the Northern Minnesota Ore Co.), the Montgomery Hill, and the Eureka mines, in the Cushman district, and at the Cason, the Allen, the Ozark, and the Ball mines, in the Batesville district. In addition to these mines, about 25 or 30 men were engaged as individual lessees on various properties. Five steam shovels were at work in 1923. In July, 1927, one steam shovel was in operation stripping surface soil. In the Cushman district, with the exception of the Miller & Rinehart operations, mining was confined to leasing, and only pick, shovel, and wheelbarrow were employed.

In 1917 the Northern Minnesota Ore Co. was organized with a capital of $2,000,000 and outstanding stock of $719,372. The company was interested in iron ore lands on the Cuyuna range, Minnesota. In 1919 it acquired 600 acres of manganese-bearing land in the Cushman district; this acreage included the Brooks' Hill, or Aydelott, property. The operation of the Arkansas property of this company was not on a commercial scale, and in 1927 an attempt was being made by the local stockholders to salvage a part of their investment from the assets of the company. In 1924 the Ball mine in the Batesville area was equipped with a steam shovel and concentrating plant. More than $80,000 was expended. After a small production the property was shut down, and an attempt was made to recover a part of the investment by the sale of the equipment.

Late in 1927 the M. R. W. Mining Co., of Memphis, Tenn., took over the Cason mine and erected a pilot mill on Miller Creek for the concentration of the Cason shales; manganese is disseminated through these shales in the form of buttons known as "button ore." The mill has a capacity of 120 tons per 24 hours, and the plant is equipped with crusher, rolls, rougher jigs, and five cleaner jigs. The fines are table concentrated. Fifteen tons of concentrate, running 37 to 40 per cent of manganese, is recovered from 100 tons of ore treated. The company has announced its intention of constructing a large mill to handle 200 tons of ore per shift.[6]

In 1926 a company known as Miller & Rinehart was formed. Its property is located on the Polk Bayou, in the vicinity of Blowing Cave. The operations of this company represent the first definite effort in the district for the recovery of the fine manganese oxide contained in the residual clays. The property is equipped with an experimental mill, which consists of two 35-foot log washers, Oliver classifier, Wilfley tables, and a 35-foot rotary drier. The method of mining the ore consists of a partial stripping with a steam shovel, followed by pick, shovel, and wheel-barrow work. The surface of the bed rock limestone on which the residual clays are found is very irregular with extensive solution channels and potholes among residual pinnacles of limestone. The clay containing manganese is trammed to the mill and delivered to the log washers. There is no overflow from the log washers; they are used solely as agitators. The discharge from the log washers, including the wash-water sand and ore, is passed over a fine screen; the undersize from the screen is flushed to Dorr Grade C classifiers. The product from these classifiers is treated on Wilfley tables. The oversize from the first screening is crushed by roll to a 10 mesh and then concentrated on the Wilfley tables. The concentrates are passed through the rotary drier where the moisture is reduced to less than 7 per cent. The capacity of the mill is about 100 cubic yards per 12 hours, and the recovery is 20 tons of concentrate of approximately the following analysis: Mn, 20 to 25 per cent; Fe, 18 to 20 per cent; SiO_2, 14 per cent; Al_2O_3, 12 per cent. The rejects and tailings from the tables, containing from 16 to 18 per cent of manganese, are impounded in a tailing pond. The crude ore contains about 12 per cent of manganese. The product of the mill is being purchased by the Tennessee Coal, Iron & Railroad Co. at 42 cents a unit. Miller & Rinehart control more than 1,000 acres of land on Skunk Creek, and they claim that the results of drilling and test stripping indicate several million tons of concentrating ore.

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[6] Engineering and Mining Journal: Vol. 124, Oct. 29, 1927, p 707.

In December, 1925, the Arkala Manganese Ore Co., operating in the Batesville-Cushman district, purchased 608 acres of manganese-bearing land, including the Roach Hill, Eureka, Sis Clark, Montgomery Hill, and the Aydelott section (as distinguished from the Aydelott mine). Several miles of narrow-gauge railway were laid down. The washing plant of the Eureka mine was renovated and equipped to handle 300 cubic yards a day. The mill was equipped with two 30-foot log washers, four compartment McLanahan-Stone jigs, belt conveyors, etc. The company surmised that the dumps of the old mine contained a very large tonnage of ores amenable to concentration. This, however, proved incorrect. In July, 1927, more than 100 men were employed, and mining was being carried on in five different localities by the open-pit and quarrying system. Owing to the irregularity of the bedrock and to the pinnacles of limestone, steam-shovel mining had to be abandoned. The residual clays delivered to the mill were said to carry from 10 to 12 per cent of manganese. Thirty-five to 40 tons of concentrates were produced daily, averaging 20 to 22 per cent of manganese, 20 to 22 per cent of iron, and 18 to 24 per cent of silica. The tailings averaged approximately 8 per cent of manganese. The product was handled by the Sloss-Sheffield Steel & Iron Co. and was shipped to the Tennessee Coal, Iron & Railroad Co., the shipper receiving 40 cents a unit f. o. b. Birmingham, Ala. The Arkala Manganese Ore Co. ceased work on July 31, 1927, after spending about $350,000.

Most of the production of the Batesville-Cushman area during 1927 was purchased by the Tennessee Coal, Iron & Railroad Co. The following schedule, f. o. b. Cushman, prevailed: 20 to 25 per cent of manganese, 42 cents per unit; 25 to 30 per cent, 44 cents; 30 to 35 per cent, 46 cents; 35 to 40 per cent, 50 cents; 40 to 45 per cent, 55 cents; 45 per cent and above, 60 cents.

The freight rate to Birmingham, Ala., is $3 a ton on ore containing less than 35 per cent of manganese and $3.53 a ton on ore containing more than 35 per cent. The freight rate to East St. Louis is $2.92.

CALIFORNIA

In 1927 no manganese ore of any grade was produced in California. In 1926, 393 long tons of ore containing over 35 per cent of manganese was shipped.

From time to time over many years California has produced manganese ore, and the greatest production has come from the old Ladd mine. This property was first worked in 1867. During the war the property was operated by the Western Rock Products Co., and about 10,000 tons of ore was produced and approximately $96,000 was received from the sale of the product. With the exhaustion of the oxide ores and the encountering of rhodochrosite ore in depth, mining was stopped. The experimental work in the sintering of the rhodochrosite ores of Butte indicates the possible application of this method to the carbonate ores of the Ladd mine.

COLORADO

In 1927 Colorado produced a small quantity of manganese ore and 26,828 long tons of ferruginous manganese ore, exclusive of fluxing ore, containing 19 to 25 per cent of manganese. In 1926 there were no shipments of manganese ore, but the shipments of ferruginous manganese ore amounted to 2,925 tons. In July, 1927, the Star group of mines started shipping at the rate of 40 cars (capacity 50 tons) of 20 per cent ferruginous manganese ore per month. The ore was shipped to the Colorado Fuel & Iron Co. under the following schedule: 20 per cent manganese (natural), 30 cents per unit; iron, 6.5 cents per unit; phosphorus not to exceed 0.1 per cent. The analysis of this ore is as follows: Manganese, 19.6 per cent; iron, 20.4 per cent; silica, 7.41 per cent; phosphorus, 0.043 per cent; moisture, 17 per cent. The freight rate to Pueblo is $1.90 per short ton. In addition to the shipments made by the Star group, a small production was made from the Jason, Stevens, and William Wallace mines.

Iron-manganese ore is widely distributed in the Leadville district. Carload lots of some of this iron-manganese ore have contained as high as 42 per cent of manganese. During 1918 to 1924 the ore shipped from the A. Y. mine averaged 38 per cent and much of that from the Carbonate exceeded 40 per cent. All the mines on the west slope of Carbonate Hill contain some iron-manganese ore bodies. A manganiferous iron area, embracing the Wolcott, Hibschle, Northern, and A. Y. mines, occurs in the Down Town area. Manganese-iron ore is found in the area neighboring the Buckeye, Hazzard, and Heystrossar mines. On the west flank of Fryer Hill low-grade manganese-iron ore is found, extending in a northerly and southerly direction from the All Right No. 2 and No. 3 to the Fairview No. 5 on the south. The ore found in the old mines in this area has a tenor of from 20 to 35 per cent of manganese. Manganese-iron ore occurs on

Fryer and East Fryer Hills, in an area embraced by the Chrysolite, Climax No. 1, Virginius Nos. 1, 2, 3, Amie, Harvard No. 1, Dunkin No. 4, Forepaugh, and Little Sliver mines, and extends to the Denver City on Stray Horse Ridge. In the Jason shaft on Poverty Flat low-grade iron-manganese ores were encountered. On the south side of California Gulch an area possibly one-half mile in diameter, with the Columbia No. 2 as a center, seems to have possibilities for the production of manganese-iron ores. South of this area in the vicinity of the Stevens and Nisi Prius mines is a small reserve of ore containing 25 per cent of manganese. Manganiferous iron ore is found in an area covered by the No. 4 incline, the Triangle, and the Doyle workings.

Because of the rapid deterioration of the idle mines and caving of old workings in Leadville a large tonnage of manganese ore becomes unavailable annually.

Outside of the Leadville district no ferruginous manganese ore was produced in the State during 1927, nor in late years have any new discoveries of commercial importance been made.

GEORGIA

Shipments of high-grade ore, containing 35 per cent or more of manganese, from Georgia amounted to 489 long tons in 1927, compared with 3,251 tons in 1926. Shipments of ferruginous manganese ore in 1927 amounted to 20,015 tons and were made by 16 shippers, compared with 18,414 tons made by 17 shippers in 1926. Shipments of manganiferous iron ore in 1927 amounted to 195 tons compared with 6,547 tons in 1926. With the exception of small shipments from Cedartown in the Cave Springs district, the production of manganese ore in Georgia is now confined to the Cartersville district. During the war small tonnages of ore were produced from the Draketown district in the southern part of the State, and from the Tunnel Hill district in Catoosa County, the Barnell-Cohutta district in Whitfield County, and the Doogan Mountain district in Murray County. Occurrences of manganese are found in Bartow, Fannin, Gilmer, Pickens, Cherokee, Paulding, and Haralson Counties. During the latter part of 1927 the exploitation of the Aubrey Cut on the Hurt property was undertaken. The ore and clay is to be hydraulicked to a sump and delivered by suction dredge to a classifier or washer, and jigs are to be installed. It is claimed that this property will produce about 20,000 tons of high-grade ore annually.

IDAHO

In 1927 the shipments of high-grade ore containing 45 per cent or more of manganese from Idaho amounted to 3,181 long tons. The mining of manganese in Idaho is confined to the Cleveland area, Bannock County. The initial shipments were made in 1926 and amounted to 830 tons of high-grade ore. The establishment of a pig-iron industry by the Columbia Steel Co. at Ironton, near Provo, Utah, has made possible a production of manganese ore from the Cleveland area. The freight rate from Grace to Provo is $2.50 a short ton. During 1927 a considerable amount of development work has been done, and it is claimed that more than 30,000 tons of high-grade ore has been developed.

A full description of this area is given in United States Geological Survey Bulletin 795–H, A Manganese Deposit of Pleistocene Age in Bannock County, Idaho, by D. F. Hewett. In reference to the reserves of this area, Hewett states on page 218:

> The yield of the part of the lowest zone that has been explored in the lowest tunnel indicates that it may be expected to yield about 3,000 tons of shipping ore to the acre. Although exploration has not yet determined the extent of the principal bed, it would be surprising if the bed were persistent over more than a few acres. If more than one bed is found, however, the reserve would be correspondingly increased.

MICHIGAN

No high-grade manganese ore is shipped from Michigan. In 1927 shipments of ferruginous manganese ore, carrying an average of about 17 per cent of manganese, amounted to 14,763 long tons, compared with 107,202 tons carrying an average of 13.49 per cent of manganese in 1926. In 1927 a total of 59,976 tons of ore averaging nearly 10 per cent of manganese was shipped; no ore containing between 5 and 10 per cent of manganese was shipped in 1926. In 1927, 402,916 tons of ore containing 3.51 per cent of manganese, natural, or 3.76 per cent of manganese, dry, was shipped, compared with 398,236 tons containing 3.42 per cent of manganese, natural, or 3.67 per cent of manganese, dry, in 1926.

MINNESOTA

In 1927 shipments of ferruginous manganese ore from Minnesota amounted to 6,276 long tons, compared with 158,759 tons in 1926. The shipments of manganiferous iron ore amounted to 934,599 tons in 1927 and 799,458 tons in 1926. The average manganese content of the shipments of 1927 was above 7 per cent. In spite of the falling off of the shipments of iron ore from the Lake Superior district in 1927, the demand for ferruginous manganese ore and manganiferous iron ore, as well as iron ore containing from 2 to 5 per cent manganese, was greater than at any time in the history of the mining of this material. In consequence the activity in the mining of these grades of ore on the Cuyuna range was greater than it had been at any time in the past. As an example, the Manganiferous Iron Co. has taken over the lease of the Mangan Iron & Steel Co. on the Mangan No. 1 property, near Ironton, adjoining the Louise mine. The Mangan mine was developed in 1916, and about 135,000 tons of manganiferous iron ore was shipped from the property before it was closed down in 1920. The State tax commission estimates a reserve of 243,000 tons of ore remaining. The same company has taken an option on the Hill Crest mine.[7]

Since July, 1926, experimental research work for the beneficiation of low-grade manganese ores by hydrometallurgy has been carried on at the University of Minnesota under the auspices of the Bradley-Fitch Co. The process involves the use of ammonium sulphate as the principal reagent. A 10-ton pilot plant has been in operation since July, 1926. It is said that the experimental work has resulted satisfactorily, and that a commercial plant will be erected in 1928 for the treatment of low-grade manganese ores.

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[7] **Engineering and Mining Journal: Vol. 124, Dec. 31, 1927, p. 1066.**

MONTANA

The shipments of metallurgical ore from Montana in 1927 were 10,124 long tons, as compared with 5,713 tons in 1926. The shipments of chemical ore, 70 to 72 per cent dioxide, were 16,382 tons in 1927 as compared with 17,904 tons in 1926. In 1927 the shipments of ferruginous manganese ore were 10,332 tons, whereas in 1926 there were no shipments of such ore. The shipments of metallurgical ore in 1927 were made from the Butte and Philipsburg districts.

Butte district.—In the Butte district approximately 6,400 tons of rhodochrosite ore containing 37 per cent of manganese was calcined, and nearly 4,000 tons of concentrate containing 56.5 per cent of manganese was produced and shipped. In 1926, 1,263 tons of crude ore (metallurgical) was shipped. The shipments of metallurgical manganese ore from the Butte district in late years have consisted of the mineral rhodochrosite. The occurrences of high-grade manganese oxide ores are widespread, but the total quantity is small and the ore is high in silica. The expense of separating the silica from the manganese renders these occurrences of no commercial importance at present. The minable carbonate ore bodies have been found in the Black Chief lode. This lode is traced on the surface for about 2 miles and ranges in width from 20 to 80 feet. In places the lode is a single vein more than 50 feet wide, and in other localities it includes several smaller parallel veins. The greatest vertical depth attained by development work in this area is 1,500 feet. This area is controlled by the Emma, Czarina, Ancient, and Travona mines. During the war period, 1917–1918, the Ancient and Travona mines produced 16,350 tons, and both were shippers in 1919; no ore has been shipped from them since 1919 except a small shipment from the Travona mine in 1923. The reserves of ore are given in the records of the War Minerals Relief Commission as 218,000 tons of rhodochrosite ore of a tenor of 30 per cent manganese. In 1927 the properties were leased to the Domestic Manganese Development Co.

The Emma mine, owned by the Butte Copper & Zinc Co. and leased to the Anaconda Copper Mining Co., has been the largest producer of rhodochrosite ore in the United States. The property was developed primarily for its zinc-silver ores. Late in 1917 rhodochrosite ore was used to grade a road near the Washoe sampler, and shortly thereafter a trial shipment was made to steel manufacturers in the East.[8]

The shipments of rhodochrosite from the Butte district from 1917 to 1927, inclusive, approximated 210,000 tons.

A. J. Seligman, president of the Butte Copper & Zinc Co., courteously permits publication of the following estimate of reserves: Emma mine, manganese oxide ores found in various outcrops and shallow deposits containing a high percentage of silica, 15,000 tons; rhodochrosite, developed and probable ore, 282,000 tons, indicated possible ore, 100,000 tons. The Czarina mine is undeveloped, but reserves have been estimated at 100,000 tons.

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[8] Pardee, J. T., Deposits of Manganese Ore in Montana, Utah, Oregon, and Washington; Contributions to Economic Geology: U. S. Geol. Survey Bull. 725, 1921, pp. 174–175.

The reserve tonnage as computed allows for ore now developed or in the process of being developed on the Black Chief lode and does not take into consideration ores that may be developed below the now deepest level. The Emma shaft is 1,400 feet deep, and the lowest workings of the Travona are 1,500 feet. From the bottom of the Emma shaft drifts have been driven which cover only a fractional part of the total length of the main lode. Immediately south of the Black Chief lode is a manganiferous area in the Ophir and Star West veins. Not enough development work has been done in this area to indicate possible reserves. Large reserves of mixed rhodochrosite and rhodonite, which have been attributed to the Butte area, have been found in and adjacent to the Rainbow lode. This lode is traced for 3 miles and embraces the veins on which the Alice, Moulton, Elm Orlu, and the Black Rock mines were located. Over a considerable part of the area the vein has been developed to a depth of 2,000 feet and a width ranging from 40 to 100 feet.[9]

In the early part of 1927 the Anaconda Copper Mining Co. entered into a preliminary contract with the Lavino Co., of Reusens, Va., covering a period of 30 days. It was agreed that the Anaconda company was to develop a process for sintering and nodulizing the rhodochrosite ores. About 6,400 tons of 37 per cent ore was shipped to the rotary kilns of the Three Forks Portland Cement Co., at Trident, Mont. The formation of rings on the inside of the kiln caused difficulty which was later partly overcome. The method employed involved the use of coal as fuel. Nodules of manganese, having a tenor of 55 per cent manganese and ranging in size from fines to the size of a large turkey egg, were obtained. As a result of this work the Anaconda company and the Domestic Manganese Development Co. entered into an agreement whereby the Anaconda company was to furnish the development company with 250 tons of rhodochrosite ore a day. It is said that the contract calls for more than 225,000 tons of ore in the next three years and for the erection by the development company of a suitable plant for the treatment of the ore. The development company has acquired the old Butte Reduction Works from the Anaconda Copper Mining Co. and in the latter part of the year was remodeling the plant. It is estimated that the initial output will be 6,000 tons of finished product per month. The equipment comprises two 8-foot by 125-foot kilns, utilizing powdered coal as fuel, and six 6-pole magnetic separators of the Wetherill type. The ore is to be delivered to the Washoe sampler, where it will be crushed to pass a 2½-inch ring, then reshipped to the sintering plant. The magnetic separators are placed ahead of the kilns. This arrangement is reported to effect a comparatively clean separation of rhodochrosite and to reduce the silica or insoluble to approximately 3 per cent as the ore is delivered to the kilns. It is expected that the plant will be in commercial operation in the early part of 1928. In addition to its leases in the Butte district, the company controls several properties in the Philipsburg area.

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[9] Pardee, J. T., Manganese at Butte, Mont.; Contributions to Economic Geology: U. S. Geol. Survey Bull. 690, 1918, pp. 116, 127.

Philipsburg district.—In 1927 the Philipsburg district shipped 16,382 tons of chemical ore and 6,010 tons of metallurgical ore, compared with 17,904 tons of chemical ore and 4,450 tons of metallurgical ore in 1926. In 1927, 10,332 tons of ferruginous manganese ore were shipped; the major part of this tonnage consisted of tailings. There was no production of this grade of ore in 1926.

The mining of manganese in the Philipsburg area is of comparatively recent origin. In 1900 a small shipment was made, but not until 1917 was Philipsburg recognized as the largest source of manganese dioxide in the United States. It was found that, as " chemical " or " battery " ore, the physical qualities of this ore were so superior to those of foreign ores that even though the available oxygen is not as great as in foreign ores the product gave greater service. Nearly 43 per cent of the total war-time production of domestic manganese ore came from this area. In 1917, Umpleby[10] estimated the reserves of oxide ores at 135,000 tons. Pardee[11] estimates the reserves as follows:

> The exploratory work done prior to November, 1918, was sufficient, however, to make reasonably certain the existence of a minimum reserve of 130,000 tons of oxide ore, with an additional possible reserve of 350,000 tons. These estimates represent the ore bodies confined to the oxidized zone, which extends from the surface to a depth ranging from 100 to 200 feet. At greater depths manganese carbonate is the prevailing variety of ore, and although these lower parts of the deposits have been only slightly explored, there is reason to think that they are extensive and capable of yielding a large quantity of ore. Material that contains less than 25 per cent of manganese but is suitable for concentration is moderately plentiful in the district. Estimates made in October, 1918, of the amount of such material in reserve range from a minimum of 56,000 tons to a maximum of 230,000 tons.

During 1917 and 1918 a quantity greater than Umpleby's estimate of the reserves was shipped, and since 1916 about 370,000 tons has been produced. The production has come, broadly speaking, from a depth not exceeding 200 feet. As the permanent water level of the district has been estimated by J. T. Pardee, of the United States Geological Survey, to lie at a depth of 700 feet, and as the area in which manganese ore occurs embraces 700 acres, it may with a reasonable degree of assurance be assumed that the present reserves would aggregate 500,000 tons of oxide ore. The evidence seems conclusive that the pyrolusite and psilomelane ore in the oxidized area will be replaced by rhodochrosite below the zone of oxidization and that manganese ores available for mining in this district will not be exhausted for many years.

The oxides of manganese are found in a relatively small area of sedimentary rocks, surrounded by green hornstone on the west, north, and east, and by granite on the south. With the exception of the granite on the extreme southwest, the formations are flanked by intrusive granodiorite. The manganese occurs mainly in a system of east and west veins. These veins are traceable into the granite, but here they lose their manganese content and have been developed and mined for their zinc-lead-silver ores, as in the Headlight, Moorlight, Algonquin, Trout, and Hickey properties. In places the manganese veins appear to follow the bedding planes of the limestone but probably do not, as the dip of many veins is greater than the dip of the bedding of the limestone.

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[10] Umpleby, J. B., " The Manganese Deposits of Philipsburg, Mont." : Min. and Sci. Press, vol. 115, p. 725, 1917.

[11] Pardee, J. T., Deposits of Manganese Ore in Montana, Utah, Oregon, and Washington; Contributions to Economic Geology : U. S. Geol. Survey Bull. 725, 1921, p. 147.

The Trout mine, operated by the Trout Mining Co., is apparently owned jointly by this company and the Philipsburg Mining Co. The property is under the management of E. A. Fritzberg. The holdings consist of eight full mineral claims, seven of which are known to contain deposits of manganese of commercial importance. The property is developed by a shaft 280 feet in depth to what is known as the tunnel level. From this level a shaft has been sunk 320 feet, making a total depth of 600 feet. The mine has been developed by levels at 80-foot intervals. As the ground is heavy and does not stand well, no work has been done more than 500 feet from the shaft. On the 300-foot level an ore shoot more than 400 feet long and averaging 30 feet in width has been proved. The faces are still in ore. Raises and winzes in ore from this level indicate that the vertical extent is in excess of 450 feet. This ore body has been developed on the Gem and Pocahontas claims. Crosscutting from the 300-foot level on the Trout claim has resulted in developing an ore shoot that has a proved length of 100 feet and an average width of 20 feet. This ore shoot outcrops on the surface and has also been encountered on the 400 and 500 foot levels. E. A. Fritzberg estimates a reserve of 135,000 tons of chemical ore.[12] This seems to be conservative. In addition to the tonnage mentioned, it is estimated that over 250,000 tons of milling ore is indicated above the 400-foot level, from which approximately 100,000 tons of concentrates may be produced. The manganese ores of the Philipsburg area consist largely of pyrolusite associated with small amounts of braunite, psilomelane, and wad. The persistency of the veins, the length of the ore shoots, the possible depth of ore, and the possibilities of encountering bodies of workable carbonate ore below the oxide zone all indicate a promising future for the manganese mining industry in this locality. With the exception of the activities of the Trout Mining Co. and the Moorlight Mining Co., mining has been done largely by lessees.

The district at present has a monthly pay roll of approximately $30,000, paid to 200 men engaged in the mining of manganese. The larger part of the tonnage shipped is chemical ore; the balance consists of metallurgical ore and of tailings. The tailings are mainly from the abandoned mill of the Philipsburg Mining Co. At present two 100-ton mills are in operation, namely, the Trout and the Moorlight. Since early in 1925 the Trout Mining Co. has been operating a mill that was built for the treatment of the company's ores. The ore or mine run is passed over a 1½-inch grizzly. The oversize is crushed in a 9 by 16 inch Blake type crusher, and the undersize and crushed material is delivered to a drier by a 6-inch belt conveyor. The drier is of the Ruggles-Coles type, 30 feet long and 5 feet in diameter; nut coal is used as fuel. The gases as well as the dust from the drier are drawn into an 84-inch cyclone blower. The drying operation reduces the moisture from about 12 to 3 per cent. The ore from the drier is carried by bucket elevator to a Leahy-No-Blind screen with ½-inch openings; the oversize from the screen is passed through 30 by 14 inch rolls. The product from these rolls is fed to fine rolls 30 by 14 inches and is then carried over a Colorado impact screen. The undersize from screening is spread in two sizes—No. 1, 6 mesh to 14 mesh; No. 2, 14 mesh. The crushed material is stored in bins of a 200-ton capacity, from which it is fed to three type-3 Wetherill separators. The concentrates are sacked and shipped, and the dust that has collected from the drier is flumed by water to a Deister-Plat-O slimer, which recovers the major part of the manganese contained in the dust and produces a high-grade concentrate. The tailings from the table concentration are impounded and are said to average more than 20 per cent manganese. The ore treated contains from 30 to 35 per cent of manganese and 25 to 30 per cent of silica. Two and one-quarter tons of crude ore are required to make 1 ton of product containing 70 per cent of manganese dioxide, less than 0.2 per cent of phosphorus, less than 6 per cent of iron, and approximately 10 per cent of silica.

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[12] Engineering and Mining Journal: Vol. 124, Oct. 22, 1927, p. 646.

The Moorlight mill is in the main a custom mill and of the same type as the Trout. No effort is made to save the dust. The tailings from the operation are impounded and are said to contain an excess of 22 per cent of manganese. The ores treated are purchased from the lessees and producers. All of the output of the Moorlight mine is shipped to C. F. Burgess Laboratories (Inc.).

NEVADA

Nevada shipped 1,357 long tons of high-grade ore in 1927, as compared with 1,607 tons in 1926, and 3,310 tons of ferruginous manganese ore in 1927, compared with 12,205 tons in 1926. In 1927, as in 1926, the Pioche shipments went to the Columbia Steel & Iron Co. at Provo, Utah. Shipments of manganiferous silver ore from Nevada for fluxing purposes amounted to 2,161 tons in 1927, as compared with 11,051 tons in 1926. No manganiferous iron ore was produced.

In 1918 the Las Vegas manganese field in Clark County was considered an important source of domestic manganese.[13] Early in 1917 a local prospector located a mine since known as the Three Kids. The property lies about 16 miles east of Las Vegas and about 5 miles west of the Colorado River. The mine has produced, at intervals over a period of 10 years, 15,900 tons of ore having an average tenor of 39 per cent of manganese, 11 per cent of silica, 1 per cent of iron, 0.03 per cent of phosphorus, and 10 per cent of moisture. During the war period, 1917–18, 15,045 tons of ore, consisting largely of wad with smaller quantities of psilomelane and pyrolusite, was shipped. The deposit appeared to contain two bodies of ore, a tabular body 4 to 6 feet in thickness and explored over an area of 200 by 250 feet, and west of this a canoe-shaped body 300 feet long by 40 to 50 feet wide. The deposit replaces rhyolite tuff. The ore is covered by overburden about 15 feet thick, largely of detritus more or less consolidated, giving the appearance of caliche. The visible reserves are estimated to be from 1,000 to 1,500 tons of 35 per cent plus manganese.

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[13] Hale, F. A., jr., "Manganese Deposits of Clark County, Nev.": Eng. and Min. Jour., vol. 105, Apr. 27, 1918, pp. 775–777.

About 1,500 feet in a southwesterly direction from the Three Kids property is an occurrence of manganese ore, similar to that of the Three Kids, although the lens has been tilted and has a strike in a northwesterly direction. The ore lies between gypsum on the hanging wall and a foot wall of rhyolite. At one time a shaft said to have been 60 feet deep was sunk on the outcrop. From the bottom of this shaft a 50-foot drift was run, which is said to be in ore. The shaft has caved and is at present 17 feet deep and is largely in rhyolite.

NEW MEXICO

In 1927 shipments of manganese ore containing 45 per cent or more of manganese from New Mexico amounted to 2,190 long tons, as compared with 1,966 tons in 1926. Shipments of ferruginous manganese ore in 1927 amounted to 56,624 tons, containing between 12 and 15 per cent of manganese; shipments in 1926 amounted to 52,033 tons containing 12 per cent of manganese. Shipments of manganiferous iron ore in 1927 were slightly larger than in 1926.

Manganese occurs in the following counties in the State: Socorro, Luna, Grant, Dona Ana, and Sierra. The greater part of the production of manganese-bearing ores comes from mines in Grant and Luna Counties. The mining of manganese ore, ferruginous manganese ore, and manganiferous iron ore is an old industry in New Mexico, as the ores were first used as fluxes in the smelting of precious and semiprecious metals. In 1916 high-grade manganese ore was shipped from the Silver City district, Grant County, to Chicago, Ill. During the war period ores were shipped from the Water Canyon deposit in Socorro County and from the Lake Valley mine, an old silver mine, near Rincon in the same county. Ores of manganese are found over rather an extended area in this State—from Hillsboro on the north to a point 14 miles south of the north end of the Little Florida Mountain—an area approximately 60 miles long and from 3 to 4 miles wide at the southern extremity and approximately 20 miles at the northern extremity. The deposits of southwestern New Mexico that occur in the vicinity of Silver City and Fierro in Grant County, Hillsboro and Lake Valley in Sierra County, and the Little Florida Mountains and the foothills of Cook's Peak in Luna County are of four types: (1) Fissures in igneous rock partly filled with manganese minerals, (2) replacement deposits (bedded types, Hillsboro), (3) contact metamorphic deposits containing manganiferous iron ore, and (4) placer deposits. The rocks in parts of these counties where manganese deposits occur include limestone of probably Paleozoic age, sandstones of Tertiary and Pleistocene age, and igneous rocks of basalt, quartz-basalt, felsitic rhyolite, and andesite of Tertiary age.[14] Four types of ore minerals are found in this area:

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[14] Wells, E. H., Manganese in New Mexico: New Mexico State School of Mines Bull., 1918.

Manganiferous iron and ferruginous manganese ores in the Silver City district; manganiferous silver ores in the Lake Valley and Hillsboro district; manganese ore and ferruginous manganese ore in the Florida Mountains; and a low-grade manganese gangue, containing appreciable quantities of zinc, in the Fierro district. The following minerals occur in the Lake Valley and Hillsboro district: Manganite, pyrolusite, psilomelane, and wad. The psilomelane ranges from a hard ore breaking with a conchoidal fracture to a soft ore approaching wad in hardness. Botryoidal masses are common. Among other minerals of manganese found in this area in lesser quantities are alabandite, rhodochrosite, rhodonite, and manganiferous siderite, calcite, and ankerite. The most common example of manganese ore in igneous rock is found on the east flank of the Little Florida Mountain, where a fault fissure occurs in agglomerate. Little Florida Mountain is composed of agglomerate and felsitic rhyolite. This fissure has a strike of 10° west of north and is continuous from the northern to the southern boundary of the Little Florida Mountain, a distance of 4 miles. Apparently the same fissure is found in the Florida Mountains 4 miles south of the south end of the Little Florida Mountain. The fissure has a dip of 70° to the east. In the Little Florida Mountain there has been a considerable amount of cross-faulting along this fissure. Where the faults cross they are filled with gangue containing manganese and may be traced in places for more than 3 miles from the main fissure. Minor faulting occurs in the main fissure, where throws as great as 10 or 12 feet occur.

During the last few years the larger part of the production of manganese ore in New Mexico has come from the Manganese Valley mine, on the east flank of the Little Florida Mountain, Luna County, 16 miles east of Deming, the county seat. The property is 3 miles south of the northern extremity of the Little Florida Mountain and consists of 10 claims, 4 of which follow the fissure. At present it is operated by a leasing company, the Manganese Valley Mining Co. Carne, on the Southern Pacific Railroad, is the shipping point. The main fissure outcrops on this company's property at an altitude of approximately 300 feet above the floor of the Mimbres Valley. The property has been developed by drifts north and south about 60 feet below the outcrop. The portals of these drifts are in an arroya formed by a cross fault. The north drift extends 1,100 feet and the south drift about 300 feet. Wherever exposed the footwall of the main vein shows a clear cleavage. The hanging wall is not clearly defined, as in many places it has been sufficiently impregnated with manganese to form wide bodies of low-grade ore. The average width of the main fissure is probably 8 feet with a minimum of 6 feet and a maximum of approximately 30 feet. As little crosscutting has been done in either the developed or undeveloped area, the possibility of greater widths is not precluded. The vein filling from the footwall inward consists of (1) a red gouge ranging from a fraction of an inch to 12 inches wide, although in a few places this gouge is lacking and the ore comes in contact with the wall, (2) a band of ore ranging from 2 to 8 feet wide, carrying 35 per cent or more of manganese. and (3) a layer of brecciated ore, ranging from a few inches to several feet wide, in which the angular pebbles are cemented by psilomelane. This part of the vein also contains a relatively large amount of calcite and some barite. In many places the calcite is crystalline, with a veneer of manganese oxide. Next to the layer of brecciated ore the manganese minerals merge into the hanging wall. The permanent water level has been assumed to be 300 feet below the outcrop of the ore. This assumption is based upon a large amount of drilling done in the Mimbres Valley close to the Little Florida Mountain. As the mineralized veins found in the southwestern part of New Mexico were all formed in mid-Tertiary time, as most of the silver-lead ores of this area are associated with limestones impregnated with manganese (usually forming the capping for the vein), and as the Little Florida Mountain is a remnant of the upper horizon of the geological formation, the zinc ores may possibly be encountered below the oxidized zone of this fissure. Practically all the ore shipped from the property has come from the driving of these drifts and from some overhand stoping. In the north drift three winzes have been sunk, two of which are approximately 50 feet deep and the third about 85 feet. The bottoms of these winzes are in ore. More than 30,000 tons of manganese ore has been developed by this work. In one of the stopes on the south drift a vein of concentrating ore 20 feet wide was encountered, and the stope was carried 35 feet above the roof of the level. This stope indicates a considerable body of concentrating ore. The south drift at the portal has about 15 feet of backs but at its face has gained approximately 100 feet in depth, because of a cross ridge that lies a little south of the portal. As exposed in July, 1927, the face showed a footwall streak of high-grade ore about 8 feet wide. The north drift at the portal had approximately 25 feet of backs and through its entire length an average of about 60 feet. With the exception of 250 feet the entire drift is in ore. The face of the drift in July, 1927, showed 3 feet of shipping ore with a minable but unknown vein of mill dirt or concentrating ore. The mine does not require timbering. As the vein has been exposed in many places along the strike by test pitting, it is probable that ore will be encountered throughout the entire length of the vein on the company's holdings.

As already stated, the ore blocked out is estimated at approximately 30,000 tons. Assuming that the oxidized zone extends to the water level 300 feet below the drifts, the property may contain as much as 700,000 tons of concentrating ore above the water level. At present the ore is hand sorted as mined, and 1 ton of high-grade lump ore is obtained from approximately 6 tons of material mined. The discard from hand sorting contains about 22 per cent of manganese; it is dumped on the 2½-inch grizzly, the oversize going to picking tables and the undersize screened on 4-inch mesh and passed on to a 1-inch trommel. The oversize from the 1-inch screen and the middlings from the picking table are crushed and returned to trommel.

Three sizes are produced and jigged separately—five-eighths to one and three-eighths inches, five-sixteenths to five-eighths inch, and one-sixteenth to five-sixteenths inch. The oversize from the one-sixteenth to five-sixteenths product, containing approximately 18 per cent of manganese, goes to stock pile for future treatment. A single-compartment pulsating jig, 26 by 24 inches, is used in concentrating the ore. Owing to the scarcity of water the plungers in the jig are bored with 3½-inch holes; valves are fitted under each hole. The valves are closed on the down stroke and are opened on the up stroke, thus keeping the water in constant circulation. The wash water from the jig passes to a settling tank and is drained from the slimes and reused. It is estimated that 1 ton of concentrates requires approximately 160 gallons of water. The hutch from the jigs is stocked for future treatment. The ratio of concentration in the plant is 4.1 tons of crude ore to 1 ton of finished product. A representative percentage analysis of 4,000 tons shipped is as follows: Mn, 45.75; SiO_2, 2.50; Fe, 2.00; Al, 0.50; Cu, 0.078; Pb, 0.051; CaO, 5.50; Ni, none; As, none; P_2O_5, trace; MgO, trace.

The metallurgical ore shipped is paid for f. o. b. shipping point, New Mexico, as follows: 60 cents for 45 per cent Mn plus, 55 cents for 40 to 45 per cent Mn, 50 cents for 35 to 40 per cent Mn, and 40 cents for 30 to 35 per cent Mn. This schedule was in effect in July, 1927.

The eastern slope of the Little Florida Mountain varies in width from less than 1 mile to more than 3 miles, sloping gradually to the Mimbres Valley. On this slope are several cross fissures containing manganese. Fluorspar has also been noted. In the valley the formations are covered by wash from the Mimbres River.

Two miles north of the north line of the Manganese Valley mining property is the White Hill mine, which shipped during the war period about nine cars of 45 per cent manganese ore. On this property the ore occurs in a vein which crosses the main fissure. The ore shipped was mined by trenching to a depth of from 4 to 5 feet.

Four miles north of the Manganese Valley mine, on the main fissure, is the Summerville mine, which is being worked. A shaft has been sunk on the footwall of the vein to a depth of 65 feet, and short drifts have been driven north and south from the bottom of the shaft. These drifts and shafts show a footwall streak of high-grade ore of 35 per cent plus manganese, 2½ feet wide, followed by a few feet of ore amenable to concentration. The character of the vein and of the ore is similar to that of the Manganese Valley mine.

Thirty miles north of Deming, in Sierra County, is the Lake Valley mine, located at Lake Valley, the terminus of a branch line of the Atchison, Topeka & Santa Fe Railway. In the early nineties it was reported that this property had shipped more than 5,000,000 ounces of silver. The geology and the ore deposits of Lake Valley have been described by Gordon[15] and by Jones.[16] The ore bodies are found in the form of kidneys in the Lake Valley limestone. Associated with the silver ores are large beds of manganese-bearing limestone, carrying a small amount of silver. The manganese oxides found are manganite, pyrolusite, psilomelane, and wad. The water level has been encountered at 150 feet. The reserves of manganese material of a tenor of 20 per cent or more, carrying a few ounces of silver, are estimated to be more than 400,000 tons.

The largest deposits of manganiferous iron ore so far partially developed in New Mexico are found at Boston Hill near Silver City,

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[15] Lindgren, Waldemar, Graton, L. C., and Gordon, C. H., The Ore Deposits of New Mexico: U. S. Geol. Survey Prof. Paper 68, 1910, pp. 276–282.

[16] Jones, E. L., jr., Deposits of Manganese Ore in New Mexico; Contributions to Economic Geology: U. S. Geol. Survey Bull. 710, 1919, pp. 46–48.

Grant County. This area has shipped an appreciable tonnage of manganiferous iron ore, with an approximate analysis as follows: 10 to 15 per cent manganese, 30 to 38 per cent iron, 7 to 10 per cent silica, 0.01 per cent phosphorus, and 2 to 5 per cent moisture. The ore outcrops for about 2 miles. The ore body ranges from a few feet to 40 feet in width and occurs as a replacement in limestone. From various estimates it seems reasonably conservative to assume that more than 5,000,000 tons of material of the grade mentioned constitutes the reserve.

Further description of the various occurrences of New Mexico may be found in the publication by E. L. Jones, already cited.

NORTH CAROLINA

No manganese ore was shipped from North Carolina in 1927; 55 long tons, carrying 39 per cent of manganese, were shipped in 1926.

TENNESSEE

Shipments of manganese ore, containing over 37 per cent of manganese, from Tennessee amounted to 498 long tons in 1927, as compared with 1,555 tons carrying 40 per cent of manganese in 1926. The shipments of ferruginous manganese ore in 1927 were 487 tons, as compared with 953 tons in 1926. No shipments of manganiferous iron ore were reported during either year. Mining operations were confined chiefly to Carter County.

VIRGINIA

Shipments of manganese ore, containing over 37 per cent manganese, from Virginia amounted to 3,212 long tons in 1927; 2,583 tons of this was metallurgical ore and 629 tons chemical ore. In 1926 the shipments of metallurgical ore amounted to 1,998 tons, and those of chemical ore were 1,794 tons. Shipments of ferruginous manganese ore amounted to 1,029 tons in 1927, as compared with 2,135 tons in 1926. Shipments of manganiferous iron ore in 1927 amounted to 177 tons; none was shipped in 1926. The production of chemical ore in Virginia is confined to Frederick County. In 1927 the production of manganese ore in the State was confined to Bland, Frederick, and Smyth Counties.

WASHINGTON

No high-grade manganese ore was shipped from Washington in 1927. The total shipments in 1924, 1925, and 1926—16,275 long tons—came from the Crescent mine, Clallam County, Olympic Peninsula. (See Mineral Resources, 1926, pt. 1, p. 161.) In July, 1926, the developed ore was exhausted. A fault was encountered on the 400-foot level, but the lessee was unable to find the continuation of the ore body. The owner re-leased the property late in the fall of 1926, and in 1927 a considerable sum of money was expended in attempting to find the ore body. Little ore was encountered, however, until the early part of 1928, when a lens was cut having a width of more than 6 feet and a tenor in excess of 50 per cent manganese. It is reported that the property will resume shipments in 1928. This area has been described by Pardee.[17]

WISCONSIN

Shipments of manganiferous iron ore, containing 5.2798 per cent of manganese (natural), from Wisconsin in 1927 amounted to 284,470 long tons, as compared with shipments of 247,261 tons containing 4.99 per cent of manganese (natural), or 5.54 per cent manganese (dry), in 1926.

FOREIGN RESOURCES

GENERAL STATEMENT

The world's production of manganese ore in 1926 was approximately 3,300,000 long tons, of which Russia produced 40 per cent; India, 31 per cent; Gold Coast, 11 per cent; Brazil, 8 per cent; Cuba, 0.4 per cent; and Netherland East Indies, 0.3 per cent. In 1925 the world's production was approximately 2,560,000 long tons, of which India produced 33 per cent; Russia, 26 per cent; Gold Coast, 14 per cent; Brazil, 13 per cent; Cuba, 0.9 per cent; Netherland East Indies, 0.4 per cent; and Chile, 0.4 per cent.

RUSSIA

Nikopol (*Ukraine*).—According to the Russian Geological Survey, there are two deposits of manganese in the near vicinity of Nikopol: One northeast of Nikopol along the Solennaia River, the mineralized area of which covers about 150 square kilometers; the other in the vicinity of the Rietchitche River, a branch of the Dnieper. The deposits are the bedded form and occur at a depth of 10 to 35 meters below the surface. The approximate thickness of the bed is 1½ meters. The surface is composed of a black earthy material, ranging in width from 3 to 6 meters, followed by a stratum of black clay approximately 1 meter thick. Next is a bed of plastic clay, 3 meters thick, under which is a bed of argillaceous and calcareous clays containing nodules of manganese. This bed has an approximate width of 1½ meters and rests upon the underlying granite. The ore is composed chiefly of the mineral pyrolusite. The recovered manganese ore is said to have a tenor of from 45 to 50 per cent manganese, 2 to 5 per cent iron, 0.20 per cent sulphur (maximum), 0.22 per cent phosphorus; silica, not given.

Shafts are sunk to the granite and the ore is drifted out. A little water is encountered, which is easily handled by steam pumps. Both wet and dry methods have been used in the extraction of the ore from the mine. In the dry process the ore is spread on the ground in a thin layer where it is sundried. The dried ore after being crushed with a roller passes through screens, and the ore is sorted from the coarse material. The rejects are again dried, recrushed, and put through a finer screen, and the process is repeated. The material passing through the fine screen is rejected. In treating the ore by the wet process the ore is placed in large wooden vats on an iron screen of comparatively large mesh. Water is poured over it, and the material is stirred by hand. In this way the coarse ore is separated from the clays. The rejects from this process are re-treated in the same manner, except that a finer screen is used.[18]

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[17] Pardee, J. T., Manganese-Bearing Deposits near Lake Crescent and Humptulips, Wash.; Contributions to Economic Geology: U. S. Geol. Survey Bull. 795, 1927.

In the article cited Kolenski calls attention to the advantages which would accrue to the Union of Soviet Socialist Republics, as well as to France, if France would buy her supplies of manganese from the Nikopol deposits. The article states " That since the deposits of the Caucasus (Tchiaturi) have been leased to the American Harriman, it is the deposits of Nikopol situated on the River Dnieper that should occupy the first place in the importation of this metal to France." The deposits are so geographically situated that the ore may be transported by water from the mines to the metallurgical plants of France.

According to a recent report of the Geological Committee of the Union of Soviet Socialist Republics, the proportion of concentrates obtained from the ore treated in 1925 and 1926 was as follows:

Manganese ore treated and concentrates produced in Nikopol, 1925–26

Year ended Sept. 30—	Ore treated (long tons)	Concentrates obtained		
		Grade	Long tons	Ratio (per cent) to total ore treated
1925	315, 458	1	101, 803	32. 3
		2	13, 599	4. 3
		3	57, 397	18. 2
	315, 458		172, 799	54. 8
1926	845, 810	1	195, 505	23. 1
		2	156, 887	18. 5
		3	118, 373	14. 0
	845, 810		470, 765	55. 6

In 1927, 450,000 tons[19] of manganese ore was produced; of this amount, 192,774 tons was exported. Information on the disposition of the balance is not available, but the larger part was probably utilized domestically.

During the fiscal year October 1, 1927, to September 30, 1928, the Southern Russian Metal Trust (lessees of the Nikopol deposits) plans to mine approximately 560,000 long tons of manganese, as compared with approximately 400,000 long tons during the current year.[20]

Manganese ores exported from Nikopol, Russia, 1926–27, in metric tons[a]

Destination	1926	1927	Destination	1926	1927
Belgium-Luxemburg	32, 575	63, 774	Italy	10, 300	14, 178
Czechoslovakia		160	Poland	38, 959	58, 426
France	98, 996	7, 610	Saar District		8, 911
Germany	38, 678	32, 522	Sweden		984
Holland		6, 193			
Hungary		16		219, 508	192, 774

[a] Allport, Fayette W., Commercial Attaché, Berlin, Letter No. 1745, Mar. 7, 1928.

[18] Kolenski, A. W., " Le manganèse de Nikopol et la métallurgie française " : La Vie Economique des Soviets No. 67, Feb. 5, 1928, p. 4.

[19] Amtorg Trading Corporation : Press release, Mar. 27, 1928.

[20] Economic Life : Moscow, July 29, 1927, p. 3.

Nikolaievsk is the port from which the Nikopol manganese shipments are exported.

The ocean freight rate varies with conditions. In 1927 at times the rate from Nikolaievsk to Rotterdam varied between 9 and 10 shillings per ton. The rate from Nikolaievsk to New York varied between $3.50 and $4 per ton.

Georgia.—In July, 1927, the Union of Soviet Socialist Republics entered into a supplemental agreement to the contract of June, 1925, with the concessionaires whereby the fixed royalties of $3 per ton in effect for three years in the original agreement were replaced by a sliding-scale royalty with a minimum of $1.50 per ton. The concessionaires were relieved of the requirement to broad-gauge the narrow-gauge line from Tchiaturi to Sharopan, and, in lieu thereof, assumed an obligation to invest approximately $3,000,000 toward improving the narrow-gauge road and equipment. They also entered into an agreement to limit the export of manganese ore from all other properties in the Union of Soviet Socialist Republics.

Reports from Moscow, dated June 19, 1928, stated that the concessionaires have withdrawn from the agreement with the Union of Soviet Socialist Republics.

The following tables illustrate the change in flow of the shipments of the Tchiaturi deposit, due in the main to the change in commercial control:

Manganese ore exported from Georgia, Russia, 1911–1913, by countries of destination, in long tons[1]

Destination	1911	1912	1913
Belgium	65,198	190,703	180,050
France	41,394	41,650	54,322
Germany	42,213	44,330	51,389
Italy	47,926	39,492	32,338
Netherland East Indies	248,578	273,655	354,634
United Kingdom	124,021	198,914	243,404
United States	15,820	94,911	135,635
	585,150	883,655	1,051,772

[1] Ghambashidze, D., Mineral Resources of Georgia and Caucasia: New York, 1919, p. 157.

Manganese ores exported from Tchiaturi, Russia, 1923, 1924, 1926, and 1927, in long tons

Destination	1923	1924	1926	1927
Belgium	5,639	32,604	59,494	14,242
France	64,636	80,954		46,457
Germany	42,653	11,866	106,660	201,515
Holland	37,106	85,144	-----------	-----------
Italy	8,720	20,339	12,185	17,872
United Kingdom	73,308	52,957	24,318	10,680
United States	127,994	194,987	181,335	250,034
Other countries	-----------	1,947	-----------	13,410
	360,056	480,798	[1] 383,992	[2] 554,210

[1] Metallurgical ore only; in addition 12,545 tons of chemical ore were shipped.

[2] Metallurgical ore only; in addition 25,800 tons of chemical ore were shipped, for which information on destination is not available.

It will be noted that the year 1925 is omitted from the table of exports of manganese ore from Tchiaturi. In June, 1925, a concession, including the manganese deposits of Tchiaturi, was given by the Soviet Government. As the shipments for the year 1925 would therefore not be typical, they have been omitted.

During 1927 the concessionaires mined 660,000 tons of manganese ore.

Transcaspia.—According to a statement by the mining department at Moscow, vast deposits of manganese ore have been discovered in the northern part of the peninsula of Mangyshlak in the Caspian Sea on the Asiatic side. Examinations carried out by Professor Bojarunas and analyses made by mining experts of the mining department show that the Mangyshlak ores are of the same first-class quality as Tchiaturi ores but that the newly discovered deposits are considerably more extensive than the hitherto known Caucasian deposits. The geological expedition of Professor Bojarunas estimated the quantity of visible ore to be at least 6,450,000 long tons.[21]

INDIA (BRITISH)

The production of manganese in India in 1927 is reported to have been the largest yet attained and was second only to the record output of Russia in 1926. The output in 1927 is officially reported as 1,129,353 long tons. The export of manganese ore from India in 1927 was as follows:

From British Indian ports to—	Long tons
United Kingdom	211, 401
Germany	12, 805
Netherlands	12, 500
Belgium	174, 485
France	151, 100
Italy	5, 150
Japan	15, 502
United States	97, 500
Other	1, 000
From Mormugão, Portuguese India	162, 378
	843, 821

CENTRAL PROVINCES

The first shipment of ore from India was in 1893 from the Vizagapatam district. This shipment, consisting of 1,000 tons, was consigned to the United Kingdom and was received at Cardiff. For several months no buyer could be found. In 1900 the first cargo from the Central Provinces Manganese Ore Co. (Ltd.) was shipped to Middlesborough. This cargo found a ready market, and before the close of that year 25,000 tons was shipped. Seven years later the production of this mining company reached 600,000 tons per annum.[22]

A statement of the financial condition of the Central Provinces Manganese Ore Co. (Ltd.) was published for the year ended December 31, 1927. The earnings of the company for the year ended on that date were slightly in excess of 37 per cent. A dividend of 30 per cent, tax free, was declared, and £100,000 was applied to the reserves. A bonus of stock was issued on the basis of one new share for every three old shares held. It is of interest to note that in 1923, one new share for every two was given, and in 1925 two new shares for every three were issued. The original company was able to pay substantial dividends in the past when manganese was valued in the world's market at 20 cents per unit, c. i. f. Atlantic seaboard.

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[21] Engineering and Mining Journal: Vol. 124, Sept. 10, 1927, p. 425.
[22] The Englishman, "Manganese Ore Industry": Calcutta, India, Feb. 7, 1925.

The price of Indian ore decreased from approximately 38 cents per unit in 1926 to 33 cents in 1927. The Central Provinces Manganese Ore Co. (Ltd.), now affiliated with the United Kingdom Ferromanganese Co., contributes about 60 per cent to the total exports of Indian manganese ore. The reserves controlled by this company are known to be adequate for maintaining the present annual rate of production for many years.

GOLD COAST

Early reports on the Insuta-Dagwin deposits mention the detrital ores, which were thought to be confined to a depth of approximately 15 feet.[23] Subsequent development work has shown that the surface soil of the ridge on which the manganese occurs, consisting largely of massive red soil, contains nodules and fragments of manganese oxide for more than 100 feet in depth. The detrital ores are being mined at present by steam shovels.[24]

An article, entitled "Manganese and Ferro-Manganese," appeared in the Iron and Coal Trades Review, June 10, 1927, page 932. It purported to be the publication of the discussion that followed the publication of a paper on "The metal manganese and its properties: Also ores and the production of ferromanganese and its history," by Sir Robert Hadfield, read at one of the meetings of the Iron and Steel Institute. In this discussion Colonel Levey (Gold Coast Government Commercial Intelligence Bureau) stated that he wanted "to refer to the erroneous report with regard to the Americans having control of the West African deposits. That was not so. The Americans had been endeavoring for a long time to obtain concessions in the Gold Coast for the purpose of working deposits on their own, but so far they had not succeeded in obtaining a single concession of any kind in the Gold Coast Colony. Whatever manganese they wanted from the Gold Coast they had to get through the existing British company."

Manganese ore exported from the Gold Coast, 1924–1927, in long tons [a]

Destination	1924	1925	1926	1927
Belgium	6,014		12,902	27,354
Canada	6,568	50,924	45,774	61,984
France	28,859	42,134	18,213	62,812
Germany		6,695	1,953	
Netherlands		1,915		
Norway	79,538	142,973	131,746	144,432
United Kingdom	44,782	18,646	30,316	567
United States	67,641	75,370	104,029	72,056
	233,402	338,657	344,933	369,205

[a] These figures represent dry weight of ore exported, as contrasted with the figures of natural weight shown in the world table on page 214.

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[23] Ford, S. H., "Manganese in West Africa": Min. Mag. (London), vol. 17, 1917, p. 270.

[24] Kitson, A. E., "Geology of the manganese ore deposits of the Gold Coast, Africa": Am. Inst. Min. and Met. Eng., Paper No. 1622–C–1, May, 1927, p. 8.

BRAZIL

Deposits of manganese occur in the States of Bahia, Minas Geraes, Matto Grosso, Maranhão, Paraná, Pernambuco, Rio de Janeiro, Rio Grande do Norte, Santa Catharina, and São Paulo. The larger part of the production for the last two years has come from mines situated in the Castankeyra-Nazareth district of the State of Minas Geraes, some 500 kilometers by rail from Rio de Janeiro. This district is served by the Central Railway of Brazil. The area has been described by Harder.[25]

A brief description of the partly developed mines follows:

The Merid mine, formerly Morro da Mina, is 9 kilometers northeast of Lafayette Station on the Central Railway of Brazil. The mine is connected with the main line by a branch similar in gauge to the main line, which permits cars loaded at the mine to be switched from the branch line to the main line and thus to the port without transshipment. Since 1920 the property has been under the control of the United States Steel Products Co., of New York, and is operated by a Brazilian subsidiary company, Companhia Meridional de Mineração. The property comprises about 377 acres and employs approximately 450 men. During the last six years the output has averaged approximately 12,000 tons per month. The wages in the district are about 80 to 85 cents a day. The Merid mine is developed to a point where it has with ease produced 25,000 tons a month. Wide fluctuation in output has been due in part to variations in taxes, costs of transportation, and character of the railway equipment and the irregularities of its operation. Practically all the ore mined is passed over a ¾-inch grizzly. The oversize is shipped, and the undersize is in the main stored for future beneficiation. A small amount of the ore shipped is the product of a washing plant, where the discard from the ¾-inch grizzly is treated.

A. Thun & Co. (Ltd.) own and operate the Agua Preta, São Gonçalvo, and Cocuruto mines and also control a number of undeveloped manganese properties in regions where the indications seem favorable for the finding of large ore bodies. The commercial value is as yet unknown. Among these properties are the Tripuhy (near kilometer 535 on the Central Railway of Brazil), near Rodrigo Silva (kilometer 521), and a property south of Santa Barbara (kilometer 659), on the Santa Barbara branch of the Santa Fe Railway. The stock of A. Thun & Co. (Ltd.) is controlled largely by German interests.

The Agua Preta mine is on the same hill as the Merid mine of the United States Steel Products Co. The present activities are confined to the mining of detrital ore. During the first quarter of 1927 this property was producing at the rate of 2,000 tons a month. All the ore is washed and is shipped by rail from the mine to Rio de Janeiro, a distance of approximately 469 kilometers.

The São Gonçalvo mine, 12 kilometers from kilometer 464 on the Central Railway of Brazil, was operated by the Société Anonyme des Mines de Manganèse d'Oure Prête until 1921, when it was sold to A. Thun & Co. (Ltd.). The mine has been estimated to have a capacity of about 2,500 tons a month and early in 1927 was producing at the rate of 2,000 tons a month. The mining operations are confined to open-pit and underground methods. The property is equipped with a washing plant.

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[25] Harder, E. C., "Manganese ores of Russia, India, Brazil, and Chile": Trans. Am. Inst. Min. Eng., vol. 56, 1916, p. 58.

In 1921 A. Thun & Co. (Ltd.) acquired the Cocuruto mine. The deposit is 22 kilometers from kilometer 450 at Buarque Macedo on the Central Railway of Brazil. The reserves have been estimated to be more than 1,000,000 tons of high-grade ore. The property is being developed by underground mining methods and has been estimated to have a monthly production of approximately 3,000 tons.

Near kilometer 460, about 2 kilometers south of Lafayette Station on the Central Railway, are two mines known as "Companhia Brasileira de Minas Santa Mathilde" and the "Empreza de Mineraçães," owned by Brazilians. The properties are connected by narrow-gauge railway to the main line, a distance of 22 kilometers. Paiva, Sabina, and Piquery are among the mines owned by these companies. The production at present is mainly from underground workings. The ore from these properties is being shipped under the name of the "Santa Mathilde" and comes principally from the Michaela-Jurema group. During the early part of 1927 from 3,000 to 5,000 tons of ore was shipped a month.

The Paiva mine is in the vicinity of the São Gonçalvo mine.

The Piquery mine was worked from 1900 to 1908, when it was considered exhausted after a production of approximately 250,000 tons. In 1926 the production was resumed after extensive development work, and the property is said to have a considerable reserve.

The first shipment of manganese ore from Brazil was made in 1894. Charles Wigg, an Anglo-Brazilian, was the accredited shipper. The Wigg mines are near Usina, kilometer 502, on the Ouro Preto branch of the Central Railway of Brazil. The manganese area extends from Usina eastward as far as Ouro Preto, kilometer 541. The ore is found in the Itabira iron formation. Open-cut mining was attempted, but because of the narrowness of the deposit—approximately 1 meter of high-grade ore—this had to be abandoned and underground methods were substituted. The ore is high in manganese but carries from 18 to 20 per cent moisture. The mines are connected with the shipping points by standard-gauge spurs. It has been reported that the mines were closed down in January, 1926, because of poor railway service and an increase in taxes.

Small shipments of manganese ore were made in 1923 from the Diamantina district, State of Bahia, about 600 miles north by rail from Rio de Janeiro. The principal shipper was F. Brifault, French consul in Bello Horizonte.

Many deposits of manganese occur in the Miguel Burnier and Ouro Preto districts, 280 miles north of Rio de Janeiro, and small quantities have been shipped from this area. The best-known deposit is the Cachoeira mine, about 17 kilometers from the station of João Pinheiro on the Central Railway. The property is owned by Brazilians and has been estimated to contain more than 1,000,000 tons of ore.

In December, 1924, the Urucum mine, reported to be the most extensive manganese property in Brazil, was leased by the Matto Grosso Government to a Brazilian company, the Empreza de Minerações. The property is near the city of Corumbá, in the State of Matto Grosso, but lacks suitable transportation facilities. The owners propose to transport the ore by river either to Rosario or Buenos Aires in the Argentine. Since the spring of 1925 considerable exploration work has been done.

Nearly all the manganese ore produced in Brazil is exported. There is a small domestic consumption by such plants as those at Juiz da Fora and Sabara in Minas Geraes and at Riberão Preto, in the State of São Paulo.

In the Federal experimental plant in Rio de Janeiro a small amount of ferromanganese was manufactured in January, 1926. The fuel used was coal from the State of Santa Catharina.

The following export tax rates on manganese ore shipped from Minas Geraes became effective July 1, 1927:

Export taxes on manganese ore effective July 1, 1927 [1]

[Per ton of ore exported]

Class	Managanese content	Official value	Tax	Ad valorem tax, paper milreis	Special tax
	Per cent	*Milreis*	*Per cent*	*Milreis*	*Francs*
Special	More than 80	120	12	14.400	3
First	50 to 80	90	12	10.800	3
Second	49.1 to 50	65	12	7.800	3
Third	44.1 to 48	45	10	4.500	2
Fourth	38.1 to 44	30	8	2.400	1
Fifth	30.1 to 38	20	8	1.600	1
Inferior	Less than 30	15	8	1.200	1

[1] Commerce Reports, Oct. 31, 1927, p. 278.

Most of the ore shipped from Brazil to the United States comes under classification 3. The total tax, an ad valorem tax in paper milreis and the special tax in French currency imposed for the payment of the French debt, now amounts to 5.55 milreis per ton, compared with 8.66 milreis prior to July 1, 1927—a decrease of 3.11 milreis [milreis equals approximately $0.12 at the then current exchange].

The following table summarizes the disposition of manganese ore during the years 1925, 1926, and 1927:

Manganese ore produced in, exported from, and in stock in Brazil, 1925–1927, in long tons [1]

[Gross weight of ore; manganese content not reported]

	1925	1926	1927 [2]
Production: [3]			
Minas Geraes	326, 585	250, 132	242, 328
Bahia	(4)	[5] 6, 288	(4)
Exports to—			
United States	249, 324	287, 569	180, 563
Netherlands	31, 445	5, 905	
France	12, 464	9, 821	28, 590
Belgium	7, 791	11, 340	36, 992
Great Britain	5, 905		
Norway	(6)	(6)	270
Other countries	23	135	
	306, 952	314, 770	246, 415
Stocks at end of year [7]	81, 124	27, 880	[8] 23, 793

[1] Commerce Reports, Feb. 6, 1928, p. 356.
[2] 11 months, January to November, inclusive.
[3] A comparatively small amount, independently produced and consumed locally, is not accounted for.
[4] No record of production.
[5] Reported as exports.
[6] Not separately provided for.
[7] At Rio de Janeiro only; no record of stocks at the mines in Minas Geraes or other States.
[8] Stocks on hand Dec. 1, 1927.

Manganese ore produced in, exported from, and in stock in Brazil in 1927, in long tons [1]

Month	Stocks 1st of month	Produced and shipped from mines	Total ore available	Exports through Rio de Janeiro
January	27, 880	18, 203	46, 083	21, 783
February	24, 300	16, 757	41, 057	6, 000
March	35, 057	18, 594	53, 651	9, 889
April	43, 762	22, 304	66, 066	13, 557
May	52, 509	26, 626	79, 135	25, 330
June	53, 805	19, 341	73, 146	23, 028
July	50, 118	21, 782	71, 900	15, 179
August	56, 721	21, 232	77, 953	36, 551
September	41, 402	17, 154	58, 556	20, 022
October	38, 534	29, 723	68, 257	44, 785
November	23, 472	30. 612	54, 084	30, 291
December	23, 793	26, 852	50, 645	15, 942
		[2] 269, 180		262, 357

[1] Compiled by Bureau of Foreign and Domestic Commerce.
[2] Adjusted total for the year reported as 269,174 tons.

From the foregoing table it is evident that the stocks on hand at the end of 1927 were about 7,000 tons larger than at the end of 1926, when they were 27,880 tons.

NETHERLAND EAST INDIES

In 1927 the production of manganese ore in the Netherland East Indies was confined almost entirely to one mining company, the Algemeene Industrieele Mijnbouw en Exploitatie Mij., of Bandoeng, operating in the Kliripan mining district. The production of manganese in Java has been steadily increasing. Two classes of ore are produced—chemical, or battery grade (pyrolusite), and metallurgical. In 1927 approximately 15 per cent of the total shipments was metallurgical ore, compared with 21 per cent in 1926. Only 6 tons of ore was shipped to the United States in 1927. The capacity of the mines for the production of chemical ore is about 1,500 tons monthly. This tonnage can be increased easily if desired. The small sales of metallurgical ore are due, no doubt, to the distance of these deposits from the world's points of consumption and to the fact that the ocean freight rate, due to trade conditions, is high in comparison with the rates of India or Georgia (Russia).

The total production of ore of both classes in 1927 was 7,107 metric tons greater than that of 1926. Of the 1927 shipments, 12,724 metric tons was chemical ore and 2,239 tons was metallurgical ore. The larger part of the 1927 exports of chemical ore was consigned to the Netherlands and Germany.

Manganese ore exported from Netherland East Indies, 1926–27, by destinations, in metric tons [1]

Destination	1926	1927	Destination	1926	1927
Australia		119	Japan		1, 706
Denmark	473	610	Netherlands	2, 918	4, 615
France	430	1, 007	United States	1, 0 7	1, 071
Germany	2, 654	4, 257	Other countries	227	60
Great Britain	1, 724	1, 733			
Italy	1, 731	107		11, 224	15, 285

[1] Maher, D. W., Manganese Ore in the Netherland Indies: Cons. Rept. 279,934, Batavia, Java, Apr. 24, 1928.

CHILE

The following information on the 1926 and 1927 manganese situation in Chile has been received through the office of the American commercial attaché, Santiago, Chile.

Deposits are known to exist in the Province of Atacama, in the Comunas of Chañarcillo, Puquios, Freirina, Huasco, Vallenar, and El Transito; in the Province of Coquimbo, in the Comunas of Higuera, La Compañia, Andacollo, Vicuna, Samo Alto, and Illapel; and in the Province of Santiago, in the Comuna of Til-Til, and in that part of the Province of Santiago which was formerly the Province of O'Higgins, in the Comuna of Estación de Hospital.

Formerly the Mansil mine, near La Estación de Hospital, was the greatest producer of manganese in Chile, but it has been worked to such an extent that production is now costly; the Province of Coquimbo is now the principal center of manganese mining.

Manganese ore is shipped from three ports in Chile—Coquimbo, San Antonio, and Valparaiso. In 1927 there were no shipments of ore from San Antonio or Valparaiso. In 1926, 715 long tons of ore, containing nearly 47 per cent of manganese, was shipped from the port of San Antonio to the United States. This ore was sold at $16 a ton c. i. f. The freight rate to New York was $5 a ton, the shipping charges were 10 Chilean pesos a metric ton, and the export tax was 1 peso a metric ton.

During 1926 and 1927 three mines were in operation in the Coquimbo region. The Marquesa Mines, near Marquesa Station (Comuna of Higuera), are owned by W. R. Grace & Co. (American); they produced 9,622 tons in 1926 and 7,404 tons in 1927. The Santo Tomas Mines, owned by Sali Hochschild (German), produced 800 tons in 1926 and 2,500 tons in 1927. The mines of Enrique Varela (Chilean), a small group located at Marquesa, also reported production both in 1926 and 1927.

The freight rate from Coquimbo to the United States during 1927 was $5 United States currency per ton, and the inland freight rate from the ore-producing regions to Coquimbo was 7 pesos per metric ton; shipping charges were 8 pesos per ton.

By far the larger part of the exports of manganese from Chile is shipped to the United States. Small tonnages are shipped to France.

PORTUGUESE INDIA

The following is contained in a report made to the American consul, Calcutta, India, by Crescencio Lobo, F. C. I.:

> The manganese ore produced in British India and exported through the port of Mormugão was 83,125 tons in 1926. I have no knowledge of what it has been in 1927, but I presume it was near about 100,000 tons.
>
> No manganese ore is consumed in Portuguese India, and whatever is produced is exported. The exports of 1926 amounted to 3,088 tons. I have no knowledge of the exact quantity produced and exported in 1927, but I presume it must have been near about 6,000 tons.
>
> A Japanese firm has lately obtained a lease of one good mine in Portuguese India (Gôa), and considering their experience and the command of capital they have one should expect them to extract at least 6,000 tons per year provided no difficulties come on their way.

The exports of domestic ore in 1927 amounted to 2,414 metric tons.

CZECHOSLOVAKIA

At a meeting in Brussels on September 30, 1926, the steel-making industries of Germany, France, Belgium, Luxemburg, and the Saar, through their agents, signed an agreement that formed a basis for the founding of the Continental Steel Entente. On December 11, 1926, an announcement was made that the steel industries of Czechoslovakia, Austria, and Hungary had affiliated themselves with the Continental Steel Entente. The new members were granted a combined quota production of 2,141,000 metric tons of steel, of which 1,430,000 tons was allotted to Czechoslovakia.[26]

The deposits now producing manganese were formerly a part of the Austro-Hungarian Empire. In former Upper Hungary high-grade manganese ore has been produced from the Iglo district. In the southwestern part of the Bukovina district near Jacoveni, deposits of manganese occur near the Rumanian-Hungarian frontier of 1914.

These deposits have been known for more than three-quarters of a century. A description of the geology and occurrence of the manganese ore deposits in this locality is given by H. K. Scott in the Journal of the Iron and Steel Institute, volume 94, 1916, page 288. The ore, reported prior to 1920 to average 33 per cent manganese,[27] is said to occur in lenses and to consist of both oxides and carbonates. High-grade ore is hand picked from mine run, and the reject crushed and jigged. In 1926 the production of the various classes of manganese ore was 95,173 metric tons, having an average tenor of 16.82 per cent of manganese.[28]

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[26] Palmer, J. J. W., Origin and Development of the Continental Steel Entente: Trade Inf. Bull. 484, Bureau of Foreign and Domestic Commerce, May, 1927, p. 12.

The manganese-mining industry of Czechoslovakia in 1927 may be summarized as follows: [29]

> The three manganese mines located in Czechoslovakia are owned by three of the most important iron and steel producing companies in the country. The mine located at Chvaletice, Bohemia, is the property of the Vitkovice Iron Mines and Steel Corporation. It employs about 120 workmen and produced 36,303 metric tons of ore, valued at 2,451,000 crowns ($73,530), during 1926, the last year for which detailed figures are available. This quantity of ore contained 5,445 tons, or 15 per cent, of manganese and 6,898 tons of iron.
>
> Besides the mine in Bohemia, two others are located at Horka and Svabovce in Slovakia, one of which belongs to the Prague Iron Works and the other to the Berg-und Hüttenwerkesgesellschaft of Brno. Separate figures for these mines are not available, but they employ together about 200 workmen and had a combined output of ore during 1926 of 58,870 metric tons, valued at 3,756,000 crowns ($112,660). This ore contained 10,565 tons, or 18 per cent, of manganese and 1,167 tons of iron.
>
> The total output of manganese ore in Czechoslovakia during 1927 amounted to 108,400 tons. The output of the three mines is said to be largely if not entirely consumed by the steel producers to whom they belong. Exports of manganese ore from Czechoslovakia during 1926 amounted to only 1.2 metric tons, which went to Germany. Imports for the same year were:

Source	Metric tons
Rumania	2, 075
India	149
Yugoslavia	75
Poland	30
Hamburg (in transit from unidentified points)	12
	2, 341

CUBA

During 1927 the Cuban exports of manganese ore, including chemical ore, were 8,976 long tons, containing 4,211 tons of metallic manganese. In 1926, 14,112 tons of manganese ore were shipped to the United States. In 1927 two mines, La Gloria and La Magdalena, were operating in the vicinity of Santiago de Cuba.

La Gloria mine is in the Antilla district, near Palmerita and Banes. In 1927 this property produced 873 tons of chemical manganese ore, valued at $32,300. The tenor of the concentrates is reported to be 90 per cent manganese dioxide. This ore was shipped through the port of Santiago de Cuba to the United States. In preparing the ore for the market the crude ore is washed to remove the clay and is then sacked and transported by bullock carts 3 miles to the railway station at Jucaro on the central Miranda railroad. The contract price is $2.50 a ton, the railroad freight to Santiago de Cuba is $1.80 a ton, the placing of the ore alongside the vessel is $1 a ton, making a total transportation charge from mine to point of embarkation of $5.30. The ocean freight rate to Baltimore was $5 per ton for chemical ore in 1927.

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[27] Curtis, A. H., Imperial Institute Monographs on Mineral Resources, with Special Reference to the British Empire; Manganese ores: London, 1919, p. 70.
[28] Report from the State Statistical Office of Czechoslovakia.
[29] Economic and Trade Notes, No. 308, Prague, May 3, 1928.

La Magdalena mine is in the Province of Oriente west of Santiago de Cuba near Manzanillo at a small village called Pilon. During 1927, 617 tons of chemical ore, valued at $26,125, was shipped to the United States.[30] The tenor of the ore is said to be from 82 to 85 per cent manganese dioxide. The mine is 1 kilometer from the coast, to which the sacked ore is transported at a contract price of $1.50 a ton. Coastwise schooners transport it to Santiago de Cuba for $1.50 a ton, whence it is transshipped at a cost of $1 a ton, making a total transportation cost of $4 a ton.

The metallurgical ore shipped from Cuba in 1927 was from accumulated stocks, approximately 10,000 tons, referred to in Mineral Resources of the United States, 1926, part 1, page 169. This tonnage was mined in 1925 and 1926 by the Sun Development Co. from its mine near Bueycito in Santiago de Cuba. Actual mining operations at the mine were suspended in 1926, and since that time no ore has been extracted. The last of the accumulated stocks was shipped during the month of December, 1927, and consisted of about 2,000 tons. Based on the assumption that a ton of ore occupies 18 cubic feet, an approximate figure for ocean freight rate on metallurgical ore is $1.25 to $1.50 per ton to Baltimore when shipped in bulk or in cargo lots.

UNION OF SOUTH AFRICA

Lack of transportation seems to have delayed the development of the manganese deposits of the Postmasburg district. The nearest point of the manganese mineralized area is 65 miles from the present railroad. The deposits were referred to in Mineral Resources of the United States, 1926, part 1, page 170. During 1927 several companies were formed, and a large part of the mineralized area has been appropriated. Among these companies are the South African Manganese (Ltd.), Postmasburg; the Central Manganese Co. (Ltd.), Johannesburg; the Postmasburg Manganese Fields (Ltd.), Johannesburg; the Gamgara Manganese Corporation (Ltd.), Johannesburg; and the Union Manganese Mines and Minerals (Ltd.). Whether it will be practical to exploit these deposits at the present time is debatable. They apparently constitute a large but latent reserve. During the latter part of 1927 E. Kaiser, professor of geology at Munich University, examined the holdings of the South African Manganese (Ltd.). He states that the properties of the company are directly north of Postmasburg and extend in a northerly direction parallel to the properties owned by the Union Manganese Mines and Minerals (Ltd.). He comments upon the low ratio of iron and the high manganese content of these ores and summarizes his observations as follows:

> Several of my figures and details, however, already indicate that quite substantial quantities of good quality ore can easily be recovered from the areas of the South African Manganese (Ltd.). There are some difficulties, inasmuch

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[30] Copley, W. E., American vice consul, Cons. Rept. 274,123, Santiago de Cuba, Mar. 15, 1928.

as the deposits occur high on the slopes of waterless hills, but these difficulties can be overcome. It is therefore essential to deepen the present trenches down to the footwall of the ore deposits, so as to obtain more data on its thickness to enable conclusions to be arrived at as regards available tonnage. The number of trenches must be considerably added to in order to form a definite opinion. Further, the whole ore deposit has to be properly sampled and analyzed. This work, which will occupy a few months, will afford the necessary data for making calculations of tonnage. The existing trenches invariably disclose a compact ore deposit which, though folded and faulted, does not widen out like stockworks and peter out as is usually the case with metasomatic manganese ore deposits.[31]

SINAI PENINSULA

Exporting of ferruginous manganese ores from the Sinai Peninsula was undertaken in 1910, but not until 1918 was any material tonnage shipped. The shipments of ferruginous manganese ore, 1918 to 1927, inclusive, have been as follows:[32]

	Long tons		Long tons
1918	9, 287	1923	128, 164
1919	42, 723	1924	105, 740
1920	68, 033	1925	82, 509
1921	64, 098	1926	83, 209
1922	95, 275	1927 (first six months)	84, 000

During the first six months of 1927 about 84,000 tons were shipped. Very little of this ore finds its way into the United States. According to the exports declared at Port Said, Egypt, before the American consul, 2 cargoes of 6,500 tons each were shipped in 1923 to the United States; 1 cargo of 6,650 tons in 1926; and 1 cargo of 7,280 tons in 1927 (August).

AUSTRALIA

A representative analysis of the ores being mined in Western Australia near Horseshoe, 86 miles from Meekatharra, in the northwestern division, is as follows: Manganese dioxide (MnO_2), 82 per cent; manganese oxide (MnO), 2.5 per cent; silica (SiO_2), 0.5 per cent; iron (Fe_2O_3), 4 per cent; metallic manganese (Mn), approximately 54 per cent.

FRANCE

France's imports of high-grade manganese ore in 1927 amounted to 649,172 long tons, as compared with 601,003 tons in 1926. The quantity imported into France in 1927 was practically the same as that imported into the United States. France's production in 1927 was 2,667 long tons.

GREECE

Since 1912 the production of manganese ore in Greece has greatly diminished. During the past few years little high-grade ore has been shipped. Ferruginous manganese ores, however, are produced. Before the Balkan War the Kassandra mines in the Province of Salonika produced about 60,000 tons of pyrolusite annually.[33] The deposits of manganese ore found in the vicinity of Messenia were examined by N. Pappadaki, mining engineer in the employ of the Greek Government.[34]

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[31] Rand Daily Mail, Johannesburg, Nov. 5, 1927, "Postmasburg Manganese," by the Mining Editor.

[32] Minerals Division, Bureau of Foreign and Domestic Commerce.

[33] Curtis, A. H., Imperial Institute Monographs on Mineral Resources, with Special Reference to the British Empire; Manganese Ores: London, 1919, p. 73.

In summing up his impressions of the area Pappadaki states, "Although the prospecting done in the area considered is insignificant, it appears from the observations made and the geological formation of the ground that some deposits can be worked and justify more methodical and more minute prospecting." He further states, "The more recent work done in the region adjoining the territory covered by the four permits corroborates the above expressed opinion."

TURKEY (IN ASIA)

About 25 years ago the area embraced by Hasan-Chaushlar, near Tireh, Yenidji-Keuy, near Makri, and Karadji, about 30 kilometers northwest of Makri, produced approximately 1,000 tons of manganese ore annually. It has been reported that German interests have displayed considerable activity in obtaining concessions for the exploitation of manganese in southwestern Asia Minor in the Makri and Adalia mining districts. During the latter part of 1927 two shipments of mining machinery and equipment arrived at Smyrna from Hamburg. Apparently the industry is being revived.[35]

YUGOSLAVIA

For many years there has been a small production of manganese from Yugoslavia. The principal deposits are at Cevljanovic-Semizovac (Bosnia) and Radovljice (Slovenia); minor deposits are at Kopsonik, Rudnik.

The deposits near Cevljanovic-Semizovac are said to have a thickness of from 1 to 3 meters and are found in a mineralized area covering about 70 square kilometers. The ore has a tenor of from 42 to 45 per cent manganese. In 1927 one property, equipped with a 120-horsepower washing plant, employed about 100 men. In 1912 more than 12,800 tons of manganese was mined, and in 1917 the peak of production, 48,851 tons, was reached.

The Radovljice deposits are said to contain 45 per cent manganese. In 1913, 830 tons was produced. The present production is negligible.

The production and exports of manganese ore for the years 1919 to 1926 were as follows:[36]

Manganese ore produced in and exported from Yugoslavia, 1919–1926, in metric tons

Year	Production	Exports	Year	Production	Exports
1919	999		1923	5,143	400
1920	2,377	5,327	1924	4,570	889
1921	910	224	1925	2,700	
1922	1,122	531	1926	1,200	

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[34] Pisar, C. J., Manganese Deposits in Greece: Cons. Rept. 269,525, Salonika, Greece, Jan. 3, 1928.

[35] Corrigan, John, jr., Activity of German Interests: Cons. Rept. 268,643, Smyrna, Turkey, Dec. 24, 1927.

[36] Groves, H. L., Am. com. attaché, Yugoslav Manganese Production; Economic and Trade Notes 130, No. 73724, Vienna, Austria, Feb. 15, 1928.

PANAMA

In 1895 and for some years thereafter the Caribbean Manganese Co. shipped manganese ore from a number of mines, including the Soledad mine, about 35 miles southeast of Nombre de Dios, and from La Cuayca, Culebra. During 1916, 1917, and 1918 about 21,647 metric tons of high-grade ore was shipped from Panama, the larger part of which came from the Soledad mine. After 1919 no shipments were made until 1923, when approximately 800 tons of manganese ore was shipped, containing 406 metric tons of metallic manganese. The ore exported from this region consists chiefly of psilomelane with some braunite and pyrolusite, and occurs in decomposed shale in the form of irregular lenticular masses, varying greatly in size. During the war period the ore was hand picked, washed, and screened, and is reported to have contained 57.8 per cent of manganese, 4.18 per cent of silica, 2.73 per cent of moisture, and 0.06 per cent of phosphorus.[37] In an article on mining in Panama, G. C. Riddell[38] states:

> These various occurrences simply indicate the general distribution of manganese over this southern section of Panama. Some of these deposits I am certain would never be commercially useful; others might. The existence of bodies of ore that are at present concealed by the jungle is entirely possible and in fact indicated by the conditions uncovered. Systematic jungle prospecting, perhaps incidental to timber and gold activities, must determine the extent to which this southern Panama manganese can be regarded as a belt of world importance.

SUMMARY

Since 1918 the tendency of the industrial nations—particularly those whose mineral industries depend largely upon importation for their needs of raw material—has been to acquire by political and commercial control sources of mineral raw materials in foreign countries. Accompanying this movement has been a growing tendency on the part of nations in which the raw material is produced to obtain a quid pro quo to compensate for the depletion of their mineral reserves. In many cases where this policy has been actually pursued the world's flow of the essential mineral raw materials has been greatly altered.

Nations enjoying actual or virtual monoply of supply of certain mineral raw materials have heavily taxed the producing industry, in one instance deriving more than 90 per cent of the total national revenues from a single industry by increasing the rate of taxation from time to time. This has resulted in fostering the establishment of plants for the artificial production of the commodity and in turn has effected a material loss to the nation in question.

Heavy and continually increasing export duties, linked with actual Government participation in the profits of mining companies, has retarded the development of what might be termed marginal producers desiring to exploit less favored deposits. Thus, with the inevitable exhaustion of rich deposits which produce at low cost, the time will come when the present annual rate of production can not be maintained, because investment in the lower-grade properties is unremunerative under the burden of taxation, and the Government again will lose its source of revenue.

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[37] Curtis, A. H., Imperial Institute Monographs on Mineral Resources, with Special Reference to the British Empire; Manganese Ores: London, 1919, p. 100.

[38] Riddell, G. C., "Is mining to thrive again in Panama?": Eng. and Min. Jour., vol. 124, New York, 1927, p. 605.

Governments have also enacted laws which to a certain extent nationalize the raw material by restricting export of the crude product; this restriction in turn has a tendency toward fixing prices of products for home consumption. Such policy retards development of home resources and restricts investment of both domestic and foreign capital.

Again, governments have exercised restrictive control by enacting laws that govern the employment of labor and labor participation in profits, by limiting the time of possession of properties by the exploiting companies, and by requiring that domestic capital (in many cases practically nonexistent) participate in foreign companies seeking to develop resources.

The effect of export duties has been indicated in the preceding pages of this report; the exaction of high royalties is a similar practice and has much the same effect. All these governmental practices tend to place the production of mineral raw materials under a severe handicap, and the benefits to be derived from the practices seem to be only a temporary increase in local revenues.

If such regulations had been applied to the Rand, Haut-Katanga, and the Andean copper deposits, not only would present developments have been impossible, but the countries concerned would not be enjoying such reasonable revenues as are now derived from the mining industry; the present general industrial status or anticipated status would be impossible; and the world at large would have suffered from the lack of and high cost for raw materials for the manufacture of goods contributing to the general welfare and betterment of conditions and standards in all nations.

The international situation in the manganese mining industry during the year has been but little affected so far by the pressure of the potential possibilities of production from the major sources of the world. Production possibilities of the future are indicated by the production heretofore attained by three of these sources, and the statement that has been made as to the near future production to be attained by the fourth. Russia can produce more than 1,300,000 long tons, as shown by the 1926 output; India produced 1,014,928 tons in 1926; Brazil, in 1917, demonstrated capacity to produce over 500,000 tons, and it has been estimated that by March, 1928, the Gold Coast (Dagwin concessions) will be producing at the rate of 600,000 tons[39] annually. Thus we have from the four great sources a possible production of 3,400,000 tons annually.

In 1926 the world's production of high-grade manganese ore was approximately 3,300,000 tons. During 1925 and 1926 the apparent accumulated stocks in India were 423,760 tons, which, added to the difference between production, exports, and home consumption in India for 1927 makes an apparent total of stocks on hand at the close of 1927 of more than 650,000 tons. To this total should be added the stocks in Brazil, Gold Coast, Russia, etc. Since 1926 the trend in world's price of manganese has been downward.

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[39] The Iron and Coal Trades Review; "Manganese and Ferro-manganese": Vol. 115, London, June 10, 1927, p. 932.

A world-wide view of the manganese ore situation, considering past production, consumption, price, potential production, and producing capacity, makes it apparent that the four great sources can with relative ease annually produce more than enough to meet the world's demand without any contribution from other sources, which in the past have furnished from 10 to 19 per cent of the total.

During 1927 France passed the United States as the largest importer of manganese ore in the world. It is of interest to know that some years ago the Comité des Forges, which is a syndicate embracing practically all of the French metallurgical industry, decided to create a buying office charged with the purchase of all manganese ore required by France. A company was organized, known as the Société de Manganèse, which makes no profit and charges no commission on any of its operations. The running expenses of the organization are borne proportionately by the French firms making use of its service.[40]

The modification of the contract made by the Union of Soviet Socialist Republics and the concessionaires followed by its reported cancellation, the large production and large exports of the Ukraine, the modification of the Brazilian Government export duty, and the estimated doubling of the Gold Coast production by March, 1928, are some of the factors which will probably have a marked effect on the world's flow of high-grade manganese during the year 1928.

WORLD'S PRODUCTION AND IMPORTS

The greater part of the European importation of manganese ore is received through the ports of Dunkirk, France; Rotterdam, Holland; Middlesborough, England; and Antwerp, Belgium (for Germany). The movement of ore through these ports is probably due to transportation facilities to points of destination.

Despite the relatively few sources from which the world at present draws the larger part of its supplies of manganese ore, it does not seem probable that international agreement to regulate production and price could easily be reached. Such an agreement would be exceedingly difficult to maintain on account of the low cost of production in India and the Gold Coast, which have a productive capacity capable of supplying nearly two-thirds of the world's needs. Another factor is that the United States, the largest consumer in the world, has the larger part of its consumptive requirements supplied by the steel companies which have commercial control of sources from which they may draw their requirements when expedient.

The accompanying table shows that of the nations engaged in transportation of imports to the United States, Great Britain carries by far the largest part. The table also indicates the part that might be played in international trade where a nation is dependent not only for the raw material but also largely upon foreign bottoms for its transportation.

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[40] Gaulin, A., American consul general, Paris, France, Dec. 16, 1927

Nationality of bottoms carrying manganese ore into the United States, January to November, 1927, in long tons[1]

Country of origin	Flag	Long tons
Brazil	United States (Independent)	83, 350
	Brazilian	15, 700
	British	30, 650
	Dutch	6, 750
	Swedish	8, 400
		144, 850
Chile	Norwegian	1, 016
	Panaman	4, 400
		5, 416
Cuba	United States (Independent)	1, 243
	British	946
	Danish	4, 600
	Norwegian	70
		6, 859
Guatemala	Honduran	43
England	United States (United States Shipping Board)	220
	United States (Independent)	1, 500
	British	809
		2, 529
Norway	Norwegian	2, 000
Union of Soviet Socialist Republics (Black Sea).	British	119, 186
	Danish	21, 377
	German	8, 508
	Greek	7, 403
	Italian	66, 677
	Norwegian	11, 765
		234, 916
Italy	Spanish	182
Algeria	Swedish	7, 641
Gold Coast	United States (United States Shipping Board)	7, 512
	British	57, 065
		64, 577
India	United States (United States Shipping Board)	7, 500
	United States (Independent)	9, 476
	British	51, 700
		68, 676
Java	British	542
	Dutch	868
		1, 410
Summary	United States (United States Shipping Board)	15, 232
	United States (Independent)	95, 569
	Brazilian	15, 700
	British	260, 898
	Danish	25, 977
	Dutch	7, 618
	German	8, 508
	Greek	7, 403
	Honduran	43
	Italian	66, 677
	Norwegian	14, 851
	Panaman	4, 400
	Spanish	182
	Swedish	16, 041
		539, 099

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[1] Division of Statistics, Bureau of Research, U. S. Shipping Board, Sp. Rept. D. S. No. 869, Mar. 5, 1928. All figures subject to revision.

Evidently, if an attempt were made to divert the present flow of manganese ore from any one of the four great sources, the development of the world's now latent or partly developed resources would in a comparatively short time force a revision of any excessive ocean freight rate that would meet the world's then current rate. The larger steel companies have shown a growing tendency to draw from many sources their needs of manganese in order to mix various grades and thus obtain the desired analysis. In this way they can produce ferromanganese at a minimum cost for the raw material: price as well as grade is a factor that governs production. Another important factor is the tendency of nations to control politically the sources of manganese ore so as to obtain a substantial revenue through export tax from their natural mineral resources.

Manganese ore produced in the principal countries, 1923–1927, in metric tons

[Prepared by L. M. Jones, of the Bureau of Mines]

Country [1]	Percentage of manganese	1923	1924	1925	1926	1927
North America:						
Canada	35–50	181	530	----	----	----
Cuba	36–48	19, 636	25, 310	51, 638	28, 091	812
Mexico	40+	2, 246	1, 800	3, 333	3, 299	(2)
Panama [3]	50±	[4] 406	----	----	----	----
United States—						
Continental (exclusive of fluxing ore)	35+	32, 006	57, 422	99, 902	47, 000	45, 459
Porto Rico [5]	35+	2, 799	4, 698	4, 260	1, 440	1, 650
South America:						
Argentina [6]	----	----	----	----	140	230
Brazil	38–50	[5] 235, 831	[5] 159, 229	331, 827	260, 536	273, 494
Chile	40–50	4, 287	4, 243	11, 062	11, 134	(2)
Europe:						
Bulgaria	30–45	----	300	565	(2)	7
France	30+	5, 993	5, 000	4, 002	2, 625	2, 710
Germany	30+	10, 245	3, 554	144	25	30
Great Britain	30+	2, 053	2, 496	842	130	1, 048
Greece	34–43+	----	5, 726	4, 303	6, 348	5, 726
Hungary	30	403	1, 217	3, 100	(2)	(2)
Italy	30–50	9, 605	12, 189	14, 984	14, 010	9, 764
Portugal [5]	38–60	13	125	11	(2)	(2)
Rumania	42	12, 511	6, 482	5, 368	8, 353	10, 369
Russia [7]	41–48	223, 549	426, 825	676, 502	1, 334, 104	1, 109, 389
Spain	29+	28, 615	20, 840	36, 072	44, 947	36, 870
Sweden	45+	5, 045	10, 881	10, 941	15, 258	16, 800
Yugoslavia	42–45	5, 143	4, 570	2, 716	1, 244	1, 971
Asia:						
China [5]	50–55	27, 672	38, 538	43, 260	42, 460	46, 350
India—						
British	47–52	706, 210	815, 894	852, 934	1, 031, 218	1, 147, 479
Portuguese [5]	42–46	(2)	(2)	(2)	3, 089	2, 414
Japan	50+	5, 494	7, 585	12, 040	15, 209	(2)
Netherland East Indies	45–52	5, 243	8, 482	10, 997	11, 393	18, 500
Turkey	----	(2)	(2)	88	70	1
Africa:						
Algeria [5]	----	651	406	450	577	3, 817
Egypt	30+	132, 384	150, 194	80, 567	121, 868	152, 845
Gold Coast [5]	50+	141, 875	259, 441	362, 897	377, 284	(2)
Morocco (French) [5]	50	----	----	679	306	2, 696
Tunisia	30–43	1, 153	3, 220	1, 655	1, 550	2, 056
Union of South Africa	40–60	592	930	471	835	1, 300
Oceania:						
Australia—						
New South Wales	----	2, 597	4, 457	1, 183	1, 311	1, 221
Queensland	50±	75	----	----	20	246
South Australia	45–56	171	321	----	----	----
Victoria	50±	----	----	----	----	15
Western Australia	47+	[5] 22	60	----	[5] 83	[5] 30
New Caledonia	----	64	[5] 93	[5] 10	(2)	[5] 130
New Zealand [5]	52+	8	6	----	----	----

[1] In addition to the countries listed, Madagascar is reported to produce manganese, but statistics of annual output are not available. Czechoslovakia reports a production of "manganese ore," but as it has been ascertained that the product so reported averages a content of less than 30 per cent manganese and therefore would be considered ferruginous manganese ore under the classification used in this report, the output has not been included in the table. Production is reported as follows for the years listed: 1923, 42,053 tons; 1924, 79,133 tons; 1925, 54,054 tons; 1926, 95,173 tons; 1927, 108,400 tons.

[2] Data not available.

[3] Imports into the United States.

[4] Manganese content of ore.

[5] Exports.

[6] Railroad shipments.

[7] Data relate to year ended Sept. 30.

Manganese ore produced in the principal countries, 1923–1927, in long tons

[Prepared by L. M. Jones, of the Bureau of Mines]

Country [1]	Percentage of manganese	1923	1924	1925	1926	1927
North America:						
Canada	35–50	179	521	---	---	---
Cuba	36–48	19, 326	24, 910	50, 823	27, 647	799
Mexico	40+	2, 211	1, 772	3, 280	3, 247	(2)
Panama [3]	50±	[4] 400	---	---	---	---
United States—						
Continental (exclusive of fluxing ore)	35+	31, 500	56, 515	98, 324	46, 258	44, 741
Porto Rico [5]	35+	2, 754	4, 624	4, 193	1, 417	1, 624
South America:						
Argentina [6]	---	---	---	---	138	226
Brazil	38–50	[5] 232, 107	[5] 156, 715	326, 585	256, 420	269, 174
Chile	40–50	4, 219	4, 176	10, 887	10, 958	(2)
Europe:						
Bulgaria	30–45	---	295	556	(2)	7
France	30+	5, 898	4, 921	3, 939	2, 584	2, 667
Germany	30+	10, 083	3, 498	142	25	30
Great Britain	30+	2, 021	2, 457	829	128	1, 031
Greece	34–43+	---	5, 636	4, 235	6, 248	5, 636
Hungary	30	396	1, 198	3, 051	(2)	(2)
Italy	30–50	9, 453	11, 997	14, 747	13, 789	9, 610
Portugal [5]	38–60	13	123	11	(2)	(2)
Rumania	42	12, 313	6, 380	5, 283	8, 221	10, 205
Russia [7]	41–48	220, 019	420, 085	665, 820	1, 313, 038	1, 091, 872
Spain	29+	28, 163	20, 511	35, 502	44, 237	36, 288
Sweden	45+	4, 965	10, 709	10, 768	15, 017	16, 500
Yugoslavia	42–45	5, 062	4, 498	2, 673	1, 224	1, 940
Asia:						
China [5]	50–55	27, 235	37, 929	42, 577	41, 790	45, 619
India—						
British	47–52	695, 055	803, 006	839, 461	1, 014, 928	1, 129, 353
Portuguese [5]	42–46	(2)	(2)	(2)	3, 040	2, 376
Japan	50+	5, 407	7, 465	11, 850	14, 969	(2)
Netherland East Indies	45–52	5, 160	8, 348	10, 823	11, 213	18, 208
Turkey	---	(2)	(2)	87	69	1
Africa:						
Algeria [5]	---	641	400	443	568	3, 757
Egypt	30+	130, 294	147, 822	79, 294	119, 944	150, 432
Gold Coast [5]	50+	139, 634	255, 343	357, 165	371, 324	(2)
Morocco (French) [5]	50	---	---	668	301	2, 653
Tunisia	30–43	1, 135	3, 169	1, 629	1, 526	2, 024
Union of South Africa	40–60	583	915	463	821	1, 279
Oceania:						
Australia—						
New South Wales	---	2, 556	4, 387	1, 164	1, 290	1, 202
Queensland	50±	74	---	---	20	242
South Australia	45–56	168	316	---	---	---
Victoria	50±	---	---	---	---	15
Western Australia	47+	[5] 22	59	---	[5] 82	[5] 30
New Caledonia	---	63	[5] 92	[5] 10	(2)	[5] 128
New Zealand [5]	52+	8	6	---	---	---

[1] In addition to the countries listed, Madagascar is reported to produce manganese, but statistics of annual output are not available. Czechoslovakia reports a production of "manganese ore," but as it has been ascertained that the product so reported averages a content of less than 30 per cent manganese and therefore would be considered ferruginous manganese ore under the classification used in this report, the output has not been included in the table. Production is reported as follows for the years listed: 1923, 41,389 tons; 1924, 77,883 tons; 1925, 53,200 tons; 1926, 93,670 tons; 1927, 106,700 tons.

[2] Data not available.

[3] Imports into the United States.

[4] Manganese content of ore.

[5] Exports.

[6] Railroad shipments.

[7] Data relate to year ended Sept. 30.

Manganese ore imported into the principal consuming countries, 1925–1927, by countries from which imported, in long tons[1]

Importing country	Country from which imported	1925	1926	1927	Source of information
Belgium-Luxemburg Economic Union.	Brazil	6,103	2,076	----------	Official trade returns.
	British India	134,312	154,031	94,857	
	Egypt	3,037	26,498	980	
	Portuguese India	10,197	4,486	----------	
	Russia	41,221	65,819	75,183	
	Other countries	2,080	11,484	94,090	
		196,950	264,394	265,110	
France	Brazil	14,142	12,482	22,174	Commerce Extérieur de la France.
	British India	193,199	239,541	257,077	
	British West Africa	46,780	37,074	31,984	
	Russia	48,539	90,534	77,508	
	Spain	43,377	47,880	40,546	
	Other countries of Asia	42,967	40,531	34,979	
	Other countries	73,143	132,961	184,904	
		462,147	601,003	649,172	
Germany	Brazil	10,463	5,977	(2)	Official German trade statistics.
	British India	68,063	46,536	(2)	
	British West Africa	15,330	6,511	(2)	
	Dutch East Indies	1,726	4,206	(2)	
	Egypt	12,768	17,054	(2)	
	Russia in Europe	6,713	58,420	(2)	
	Russia in Asia	55,284	33,058	(2)	
	Other countries	25,879	24,208	(2)	
		196,226	195,970	367,290	
Great Britain	British countries:				Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions.
	British India	170,096	81,710	(2)	
	Gold Coast	14,148	20,844	(2)	
	Other British countries	593	56	(2)	
		184,837	102,610	(2)	
	Foreign countries:				
	Brazil	11,908	----------	(2)	
	Japan and possessions	27	----------	(2)	
	Netherlands	442	96	(2)	
	Portuguese possessions in India.	20,317	6,387	(2)	
	Russia	55,985	32,101	(2)	
	Spain	2,051	----------	(2)	
	Other foreign countries	3,080	3,114	(2)	
		93,810	41,698	(2)	
		278,647	144,308	198,527	
Japan	British India	----------	1,340	(2)	Annual Report of the Empire of Japan.
	China	43,373	41,455	(2)	
	French Indo-China	----------	----------	(2)	
	Kwantung Province	2	----------	(2)	
	Straits Settlements	8,269	52,229	(2)	
	Other countries	1,151	43	(2)	
		52,795	95,067	(2)	
Netherlands	Belgium	139	58	----------	Maandstatistiek van den in-uit-en Doorvoer.
	Dutch East Indies	1,714	1,361	1,212	
	Egypt	1,000	----------	----------	
	France	246	438	453	
	Germany	381	179	225	
	Italy (Fiume)	24	386	----------	
	Norway	5	140	----------	
	Russia in Europe	----------	----------	3,961	
	Other countries	137	2	803	
		3,646	2,564	6,654	

[1] Data compiled by Minerals Division, Bureau of Foreign and Domestic Commerce.
[2] Figures not available.

Manganese ore imported into the principal consuming countries, 1925–1927, by countries from which imported, in long tons—Continued

Importing country	Country from which imported	1925	1926	1927	Source of information
United States	Africa (British):				Foreign Commerce and Navigation of the United States.
	South	----------	12, 946	----------	
	West	66, 146	100, 614	87, 230	
	Brazil	228, 438	272, 287	174, 026	
	British India	48, 967	63, 742	93, 017	
	Canada	2, 498	417	430	
	Chile	7, 154	8, 213	3, 206	
	China	510	----------	----------	
	Cuba	12, 745	14, 112	8, 976	
	Germany	96	150	65	
	Hong Kong	1, 296	----------	----------	
	Italy	----------	6, 083	----------	
	Java and Madura	----------	594	1, 527	
	Netherlands	10	25	----------	
	Norway	----------	3, 542	----------	
	Russia in Europe	238, 618	254, 885	253, 544	
	United Kingdom	3, 275	206	46	
		[3] 609, 753	737, 816	622, 067	

[3] This figure differs from estimate shown on p. 159 and is due to difference between figures furnished by producers of Cuba and those furnished by the Bureau of Foreign and Domestic Commerce.

SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES

(MINE REPORT)

By J. P. Dunlop and H. M. Meyer

INTRODUCTION

The silver, copper, lead, and zinc mines of the Central States are in Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin. The territory thus embraced lies in the great interior valley province of the United States, which extends from the Appalachian system to the Rocky Mountain front, exclusive of the Black Hills. Most of the mines are in the Paleozoic sedimentary rocks of this province, but the copper range of northern Michigan comprises lavas and intercalated sediments of pre-Cambrian age.

In the lead and zinc regions of the Central States the material sold is mainly concentrates,[1] and payment is made according to a basic price for concentrates of a certain quality. The details of this method are given in the pages devoted to Missouri in the report of this series for 1914. The figures reported by producers represent the quantity and assay contents of concentrates sold and the amount received in payment. The total metal produced is calculated from the first two of these items.

The operators in Michigan report the quantity of concentrates produced and the actual recovery of copper from concentrates smelted. In any year the mines may produce more or less concentrates than are smelted during the same period. The copper content of concentrates produced but not smelted during the year has been estimated on the basis of the average copper recovery per ton for the year of the company producing it.

TENOR OF ORES OF THE CENTRAL STATES

Much of the ore mined in the Western States is crude smelting ore—that is, it can be smelted directly without preliminary concentration. All but a very small part of the ore from the Central States, however, is of such tenor that it requires concentration. The only fair basis for comparison of the relative magnitude of mining operations in different States is that of quantity of crude ore, or "dirt." In Kentucky and southern Illinois the lead and zinc concentrates are recovered as by-products in the concentration of the fluorspar that they accompany, and it is not possible to calculate the metal content of the crude ore raised.

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[1] In local usage the ore as mined is called "dirt" and the concentrates are classed as "ore." Where the capacity of a concentrating plant is given, such capacity is to be understood as based on a 10-hour shift unless otherwise stated.

In Arkansas very little ore has been mined for several years, and the average tenor calculated from the output of ore during these years would not present an accurate comparison with the tenor during a period of active mining.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in the Central States, 1925–1927, by States

State	1925		1926		1927	
	Ore	Metal content [1]	Ore	Metal content [1]	Ore	Metal content [1]
	Short tons	*Per cent*	*Short tons*	*Per cent*	*Short tons*	*Per cent*
Illinois (northern)	232, 000	1. 49	245, 100	1. 49	88, 200	0. 82
Kansas	4, 165, 000	3. 87	4, 717, 500	3. 66	4, 505, 800	3. 38
Michigan	7, 036, 751	1. 10	7, 641, 682	1. 15	8, 046, 334	1. 10
Missouri	6, 872, 000	3. 38	7, 287, 100	3. 30	6, 824, 000	3. 28
Oklahoma	10, 605, 200	3. 81	10, 934, 000	3. 48	9, 932, 400	2. 89
Wisconsin	1, 003, 700	2. 72	1, 440, 300	2. 51	1, 480, 800	2. 93
	29, 914, 651		32, 265, 682		30, 877, 534	

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[1] The percentages given in this column represent the metal content of the ore in so far as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in the other Central States the metals are lead and zinc. the relative proportions of which are shown in the table on another page and in the tables of tenor of ore given in the sections devoted to the respective States.

The marked loss in 1927 shown by this table was distributed among the lead and zinc mines of Oklahoma, southwestern Missouri, Kentucky, Illinois, and Kansas. There were increases in the output of copper ore from Michigan and of lead or zinc ores from southeastern Missouri, Wisconsin, and Arkansas.

The low average tenor of the ore treated in the Central States in 1927 is best shown by the fact that the average value of the total metal content was only $3.44 a ton of ore treated. This value was 97 cents less than in 1926, because of the lower prices of copper, lead, and zinc. The 22,831,200 tons of zinc, lead, and lead-zinc ores, old tailings, etc., treated in the Central States, exclusive of southern Illinois, Kentucky, and Arkansas, in 1927 yielded lead and zinc concentrates that sold for $60,494,470; consequently the mine operators realized an average of $2.65 a ton of ore, etc., mined and treated, compared with $3.39 a ton in 1926. The value of both lead and zinc concentrates was much less in 1927 than in 1926. The quantity of lead concentrates decreased about 47,000 tons and of zinc concentrates 156,360 tons.

SUMMARY

The total value of the mine production of silver, copper, lead, and zinc in the Central States in 1927 was $106,089,208, or $36,360,748 less than the value in 1926. The total value from 1907 to 1927 was $2,118,583,967—$833,954,802 for zinc, $676,596,831 for copper, $600,926,912 for lead, and $7,105,422 for silver. The value of the zinc has been much greater than that of the copper for the last nine years, hence the total value of the zinc produced during the period is $157,000,000 more than that of the copper.

The value of metal production herein reported has been calculated at the figures given in the table that follows. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

Mine production of silver, copper, lead, and zinc in the Central States in 1927, by States

State	Silver		Copper		Lead		Zinc		Total value
	Fine ounces	Value	Pounds	Value	Short tons	Value	Short tons	Value	
Arkansas					23	$2,898	128	$16,384	$19,282
Illinois	1,518	$861			277	34,902	521	66,688	102,451
Kansas					27,497	3,464,622	109,427	14,006,656	17,471,278
Kentucky					139	17,514	860	110,080	127,594
Michigan	97,193	55,109	177,537,775	$23,257,449					23,312,558
Missouri	233,931	132,638	451,000	59,081	198,760	25,043,760	18,737	2,398,336	27,633,815
Oklahoma					51,680	6,511,680	206,611	26,446,208	32,957,888
Wisconsin					2,069	260,694	32,841	4,203,648	4,464,342
	332,642	188,608	177,988,775	23,316,530	280,445	35,336,070	369,125	47,248,000	106,089,208
Total, 1926	198,232	123,697	176,458,565	24,704,199	307,456	49,192,960	456,194	68,429,100	142,449,956

Silver.—Nearly all the silver that has been produced in the Central States has been recovered incidentally in the production of other metals. The output in 1927 from the copper lodes of Michigan decreased 8,049 ounces from 1926, and that from the treatment of lead ore from Missouri increased 143,931 ounces. The lead-zinc fluorspar deposits of the Kentucky-Illinois field also carry silver, and the silver recovered from the lead concentrates from Illinois in 1927 was 1,518 ounces, a decrease of 1,472 ounces.

Copper.—The mine production of copper in the Central States in 1927 came from Michigan and Missouri. Michigan, which, as in other years, contributed nearly all of the output, produced 177,537,775 pounds, or 2,156,210 pounds more than in 1926. The copper produced in Missouri was all derived from matte from lead smelters, as no copper ore was shipped in 1927.

Lead.—The mine production of lead in the Central States in 1927 decreased 9 per cent in quantity. Missouri produced 71 per cent of the total, compared with 67 per cent in 1926, and the recoverable lead content of galena and lead carbonate concentrates mined in Missouri in 1927 was equivalent to 29.7 per cent of the refined primary lead recovered in the United States from domestic ore during that year. Of the total output of lead in Missouri the disseminated lead district of southeastern Missouri produced 195,990 tons, again exceeding the output of the Coeur d'Alene region of Idaho and that of the State of Utah and retaining first place in the production of lead in the United States. Small miscellaneous operations in southeastern Missouri (as noted on p. 243) resulted in the recovery of 261 tons of lead. Southwestern Missouri had an output of 2,509 tons of lead, or 1,441 tons less than 1926. The production of lead in Oklahoma as measured by the recoverable metal in concentrates sold or treated, decreased from 69,704 tons in 1926 to 51,680 tons in 1927, partly because some galena ore milled was held in bins at mines and not sold in 1927. The production from Kansas mines decreased from 28,463 tons in 1926 to 27,497 tons in 1927. Production in Illinois declined from 655 to 277 tons; in Wisconsin it increased from 1,546 to 2,069 tons. The combined output of lead from mines in the southern Illinois-Kentucky region, Arkansas, and the upper Mississippi Valley amounted to less than 1 per cent of the total output of the Central States. No production of lead has been reported from Iowa mines for a number of years.

Zinc.—The mine production of zinc in the Central States in 1927 was equivalent to 64 per cent of the total smelter output of primary slab zinc from domestic ores in the United States as compared with 75 per cent in 1926. Oklahoma produced 206,611 tons of zinc in 1927, compared with 272,567 tons in 1926. For many years prior to and including 1917 Missouri had been the largest producer of zinc in the United States; in 1917 the output of Missouri was 132,918 tons but in 1927 was only 18,737 tons. The production of zinc in Kansas rose from 56,225 tons in 1922 to 100,969 tons in 1923, 105,392 tons in 1924, 118,778 tons in 1925, 126,307 tons in 1926, but decreased to 109,427 tons in 1927. The Wisconsin output increased from 26,800 tons in 1926 to 32,841 tons in 1927, the Arkansas output increased from 87 tons in 1926 to 128 tons in 1927, Kentucky decreased from 1,838 to 860 tons, and Illinois decreased from 2,577 to 521 tons. No production of zinc has been reported from Iowa mines for a number of years.

PRODUCTION OF LEAD AND ZINC BY REGIONS

The productive lead and zinc territory in the Central States naturally falls into seven regions, three of which are not limited to a single State. For statistical purposes the tables showing the production of lead and zinc by States are necessary, but for practical purposes it is desirable to show the production by the natural regions, irrespective of State lines.

The seven regions, in order of size of output, are: (1) The Joplin region, comprising southwestern Missouri, southeastern Kansas, and northeastern Oklahoma; (2) southeastern Missouri, containing the great deposits of disseminated lead; (3) the upper Mississippi Valley region, including all the lead and zinc mines in southwestern Wisconsin, Iowa, and northwestern Illinois; (4) the fluorspar region in southern Illinois and western Kentucky; (5) Arkansas; (6) central Missouri; (7) the Arbuckle Mountain region, in southern Oklahoma.

The southeastern Missouri region produced 70 per cent of the lead output of the Central States and 29 per cent of the primary lead recovered from domestic ore smelted or refined in the United States in 1927. The Joplin region yielded 29 per cent of the lead and 90 per cent of the zinc of the Central States in 1927 and was much the largest producer of zinc in the United States, yielding 57 per cent of the total slab zinc produced from domestic ores in 1927 and 69 per cent of the total in 1926.

The lower zinc content of the zinc concentrates produced at mines in the upper Mississippi Valley region is clearly indicated by the fact that, although these mines yielded 17 per cent of the total output of raw zinc concentrates of all classes, the zinc content of such concentrates was only 9 per cent of the zinc from mines in the Central States.

The lead content of the galena concentrates shipped from the upper Mississippi Valley region averaged about 72 per cent, that of the concentrates from the Joplin region averaged about 78.4 per cent, and that of the concentrates from the southeastern Missouri region averaged 71.7 per cent. A very small proportion of the galena shipped from the Joplin region contained more than 82 per cent lead. A large part of the sphalerite shipped from the Joplin region contained 58 to 60 per cent of zinc, and more than 30,000 tons shipped from the Waco and Smithfield districts in that region averaged 61 per cent.

Mineral Resources for 1914 contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State for the period 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907.

Mine production of lead and zinc in the Central States in 1927, by regions

Region	Lead [1]		Zinc [2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin	106,472	$9,269,213	644,558	$25,046,201	$34,315,414
Southeastern Missouri	279,441	23,360,294	8,390	289,816	23,650,110
Upper Mississippi Valley [3]	3,024	245,382	133,520	2,283,564	2,528,946
Kentucky-southern Illinois	551	35,841	2,488	51,906	87,747
Arkansas	30	2,590	386	9,453	12,043
	389,518	32,913,320	789,342	27,680,940	60,594,260
Total, 1926	436,595	42,659,688	945,702	41,053,728	83,713,416
Metal:					
Joplin	81,686	10,292,436	330,530	42,307,840	52,600,276
Southeastern Missouri	196,251	24,727,626	4,245	543,360	25,270,986
Upper Mississippi Valley [3]	2,141	269,766	33,362	4,270,336	4,540,102
Kentucky-southern Illinois	344	43,344	860	110,080	153,424
Arkansas	23	2,898	128	16,384	19,282
	280,445	35,336,070	369,125	47,248,000	82,584,070
Total, 1926	307,456	49,192,960	456,194	68,429,100	117,622,060

[1] Includes both galena and a small quantity of lead carbonate concentrates.

[2] Includes sphalerite, zinc carbonate, and zinc silicate concentrates.

[3] Includes Iowa, northern Illinois, and Wisconsin.

REVIEW BY STATES AND DISTRICTS

ARKANSAS

By J. P. Dunlop

The value of the lead and zinc from Arkansas mines was $1,430,668 in 1917 but only $19,282 in 1927.

The production of galena in Arkansas is small. The shipments of zinc carbonate and zinc silicate concentrates in 1927, 386 tons, were about 2 per cent of the shipments in 1917.

Mine production of lead and zinc in Arkansas, 1918–1927

Year	Lead concentrates (galena)		Zinc concentrates				Metal content [1]			
			Sphalerite		Silicate and carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	155	$13, 594	310	$16, 450	2, 156	$68, 333	120	$17, 040	951	$173, 082
1919	35	2, 400	--------	--------	510	18, 170	28	2, 968	189	27, 594
1920	10	755	--------	--------	917	28, 925	8	1, 280	329	53, 298
1921	27	1, 510	--------	--------	42	580	21	1, 890	15	1, 500
1922	55	4, 000	--------	--------	425	6, 870	42	4, 620	134	15, 276
1923	32	2, 559	--------	--------	444	9, 919	25	3, 500	148	20, 128
1924	25	2, 730	--------	--------	13	330	20	3, 200	4	520
1925	93	8, 546	58	2, 380	44	1, 296	58	10, 092	43	6, 536
1926	28	2, 544	8	346	246	7, 012	18	2, 880	87	13, 050
1927	30	2, 590	--------	--------	386	9, 453	23	2, 898	128	16, 384

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc in 1921 to 1927. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Arkansas, 1924–1927

	1924	1925	1926	1927
Total ore .... short tons	(1)	(1)	(1)	(1)
Average lead content of galena concentrates .... per cent	80. 0	63. 4	64. 0	78
Average zinc content of zinc silicate and carbonate .... do	----------	44. 0	37. 4	38
Average value per ton:				
Galena concentrates	$109. 20	$91. 89	$90. 86	$86. 33
Zinc silicate and carbonate	$25. 38	$29. 45	$28. 50	$24. 49

[1] The quantity of ore mined was very small, and very little of it was milled, so that no calculations as to tenor are available; part of the ore sold was taken from stock in bins.

The mines are chiefly in Boone and Marion Counties and the adjoining portions of Searcy and Newton Counties, but there are numerous prospects in Baxter, Izard, Sharp, Lawrence, and other counties to the east, and deposits have been worked in Washington and Sevier Counties, on the extreme western border of the State, and in Pike County, in the southwestern part of Arkansas.

The ores are galena, sphalerite, and smithsonite, and the concentrates produced are generally of high grade and free or nearly free from iron or lime. The sphalerite and smithsonite are shown by analysis to contain appreciable quantities of cadmium, especially in a yellow variety of smithsonite known locally as "turkey fat," which shows as much as 0.8 per cent of cadmium. This was the highest content reported for zinc concentrates for the Central States until 1927, when shipments of blende concentrates from southeastern Missouri were reported as assaying 1 per cent of cadmium.

Few of the lead and zinc mines of Arkansas were worked in 1927, and none of those from which concentrates were shipped were operated steadily. Shipments of lead and zinc ores in 1927 came from seven small mines, and the value of the concentrates shipped increased from $9,902 in 1926 to $12,043 in 1927.

Shipments of lead concentrates in 1927 were mainly from the Brewer land in Newton County and from the Hampton mine in Marion County. Some zinc carbonate mined in Marion and Boone Counties by Bud Lawhorn and others was sold to L. L. Brown, of Zinc, but was not shipped in 1927. The largest shipments of zinc carbonate were from the Morning Star 350-ton mill at Rush Creek. This mill treated old tailings in 1927, but it is to handle ore as well as tailings in 1928. The Mattie May and the Monte Cristo mines on Rush Creek in Marion County shipped several cars of zinc carbonate before closing down early in 1927. In Newton County about a car of zinc carbonate was produced and shipped by C. E. Stewart and Miller & Shutt. The only output from Lawrence County was from the Hopper mine near Eaton. The Campbell mine in Lawrence County was operated early in 1927, but no shipments were made.

ILLINOIS

By J. P. Dunlop

Mine production of lead and zinc in Illinois in 1927, by districts [1]

District	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [2]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Northern Illinois	110	$8,001	2,726	$30,722	72	$9,072	521	$66,688
Southern Illinois	310	21,771			205	25,830		
	420	29,772	2,726	30,722	277	34,902	521	66,688
Total, 1926	972	95,123	13,151	179,501	655	104,800	2,577	386,550

[1] Mineral Resources for 1914 contains a historical review of lead and zinc mining in Illinois.

[2] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Illinois, 1924–1927

	1924	1925	1926	1927
NORTHERN ILLINOIS				
Total ore ..... short tons	148, 300	232, 000	245, 100	88, 200
Total concentrates in ore:				
Lead ..... per cent	0. 38	0. 27	0. 15	0. 12
Zinc ..... do	4. 72	4. 87	5. 37	3. 09
Metal content of ore:				
Lead ..... do	0. 26	0. 21	0. 11	0. 08
Zinc ..... do	1. 45	1. 28	1. 38	0. 74
Average lead content of galena concentrates ..... do	71. 2	78. 6	77. 9	66. 4
Average zinc content of sphalerite concentrates ..... do	30. 7	26. 3	25. 6	23. 6
Average value per ton:				
Galena concentrates	$93. 92	$105. 71	$104. 02	$72. 74
Sphalerite concentrates	$16. 07	$15. 64	$13. 65	$11. 27
SOUTHERN ILLINOIS				
Average lead content of galena concentrates ..... per cent	65. 6	67. 0	64. 2	67. 4
Average zinc content of sphalerite concentrates ..... do	59. 77	59. 9	-------	-------
Average value per ton of galena concentrates	$83. 19	$95. 26	$94. 28	$70. 23

Mine production of silver in southern Illinois, 1918–1927

Year	Silver		Lead concentrates, silver-bearing		Year	Silver		Lead concentrates, silver-bearing	
	Fine ounces	Value	Short tons	Ounces of silver per ton		Fine ounces	Value	Short tons	Ounces of silver per ton
1918	8, 171	$8, 171	1, 228	6. 65	1923	8, 170	$6, 699	1, 762	4. 64
1919	4, 440	4, 973	715	6. 16	1924	8, 891	5, 957	1, 678	5. 30
1920	8, 193	8, 930	1, 252	6. 55	1925	3, 000	2, 082	797	3. 76
1921	1, 345	1, 345	181	7. 43	1926	2, 990	1, 866	614	4. 87
1922	6, 025	6, 025	1, 100	5. 48	1927	1, 518	861	310	4. 90

The value of the mine production of silver, lead, and zinc in Illinois in 1927 was $102,451, as compared with $493,216 in 1926.

The lead and zinc deposits of Illinois fall into two distinct regions marked by different mineral associations and structural environment. Those of southern Illinois belong to the Kentucky-Illinois fluorspar district; those of northern Illinois belong to the upper Mississippi Valley region.

NORTHERN ILLINOIS

The lead and zinc mines of northern Illinois are all in Jo Daviess County, the extreme northwestern county of the State. The ores are galena, smithsonite, and sphalerite, although the first two are much less common now than formerly, when most of the deposits worked were shallow and above water level.

The entire output of northern Illinois is included under the Galena district, which comprises the mines from the vicinity of Fever River to the Wisconsin State line.

In 1927 there was a decrease of 64 per cent in the quantity of ore and of 79 per cent in zinc concentrates from northern Illinois, as shown in the accompanying tables. The average zinc content of sphalerite concentrates decreased from 25.6 to 23.6 per cent, and the ratio ol concentrates to ore decreased from 5.37 to 3.09 per cent. Most of the lead and zinc concentrates came from the Black Jack mine of the Mineral Point Zinc Co., whose production was much smaller than in 1926. The property was closed down late in 1927.

Tailings from the Walton land were milled by A. Hollander. Small operators did very little mining and virtually no prospecting.

SOUTHERN ILLINOIS

The lead and zinc deposits of southern Illinois are in Pope and Hardin Counties; they occur in rocks of Mississippian age in the northern extension of the Kentucky-Illinois fluorspar district. The chief product of the mines in recent years has been fluorspar, and the yield of galena is small, compared with the output from other districts in the Central States.

The total production of galena concentrates in southern Illinois from 1906 to 1927 has been 16,152 tons, most of which has been shipped from the Fairview, Rosiclare, and Hillside mines. The shipments of zinc ores from the district have been comparatively small and scattered. The only recorded shipments of zinc carbonate, aggregating 103 tons, were made from the Empire mine in 1903 or 1904 and from four companies in 1906.

Formerly large bodies of galena near the surface were worked, but galena is now produced incidentally in the concentration of the fluorspar. For this reason it would be misleading to give the quantity of crude ore. The galena of southern Illinois is notably argentiferous as compared with the rest of the Mississippi Valley ores, and the silver content averaged between 3.76 and 7.43 ounces to the ton of lead concentrate for the last 11 years.

Sphalerite, or zinc blende, occurs much less plentifully than galena. The first large shipments of sphalerite in many years were made in 1924 from the 250-ton plant of the Fairview Fluorspar & Lead Co., which reported no sales of sphalerite in 1926 or 1927.

The shipments of galena concentrates from southern Illinois decreased from 614 tons in 1926 to 310 tons in 1927, and the silver recovered in treating the concentrates decreased from 2,990 to 1,518 ounces.

The Rosiclare Lead & Fluorspar Mining Co. reported the recovery of only a small quantity of silver and lead in 1927. The mine and concentrating plant of the Hillside Fluor Spar Mines near Rosiclare were active in 1927 and produced most of the lead and silver. The shaft is 450 feet deep, and the mill has a capacity of 200 tons per 8-hour shift. The galena concentrate, assaying 67 per cent of lead and about 4.73 ounces of silver a ton, was shipped to the St. Louis plant of the National Lead Co.

IOWA

The lead and zinc deposits of Iowa extend along the Mississippi River for nearly 80 miles, in Dubuque, Clayton, and Allamakee Counties. No shipments of lead or zinc concentrates from mines in Iowa have been reported since 1917.

KANSAS

By J. P. Dunlop

Mine production of lead and zinc in Kansas in 1927, by districts

District	Lead concentrates [1]		Zinc concentrates		Metal content [2]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Crestline	3,181	$277,323	6,640	$246,535	2,533	$319,158	3,372	$431,616
Blue Mound-Baxter Springs	32,080	2,837,962	187,239	7,469,739	24,724	3,115,224	96,693	12,376,704
Galena	[1] 361	25,306	140	4,700	240	30,240	71	9,088
Waco	--------	--------	17,669	720,166	--------	--------	9,291	1,189,248
	35,622	3,140,591	211,688	8,441,140	27,497	3,464,622	109,427	14,006,656
Total, 1926	36,764	3,850,363	243,107	11,676,256	28,463	4,554,080	126,307	18,946,050

[1] Includes 154 tons of lead carbonate, containing 56 per cent lead, from Galena.

[2] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas in 1927

	Crude ore	Old tailings
Total ore and old tailings milled short tons	4,008,100	497,700
Total concentrates recovered:		
Galena do	35,416	52
Sphalerite do	205,109	6,579
Ratio of concentrates to ore, etc.:		
Lead per cent	0.89	0.01
Zinc do	5.12	1.32
Metal content of ore, etc.:		
Lead do	0.70	0.01
Zinc do	3.01	0.71
Average lead content of galena concentrates do	78.9	60.0
Average zinc content of sphalerite concentrates do	58.9	53.4
Average value per ton:		
Galena concentrates	$88.34	$59.42
Sphalerite concentrates	$40.15	$31.32

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1924–1927

	1924	1925	1926	1927
Total ore and old tailings milled short tons	3,215,000	4,165,000	4,717,500	4,505,800
Total concentrates in ore, etc.:				
Lead per cent	0.74	0.76	0.81	0.79
Zinc do	5.84	5.52	5.12	4.70
Metal content of ore, etc.:				
Lead do	0.59	0.60	0.62	0.62
Zinc do	3.50	3.27	3.04	2.76
Average lead content of galena concentrates do	79.4	78.9	79.1	78.9
Average zinc content of sphalerite concentrates do	60.0	59.1	59.0	58.8
Average value per ton:				
Galena concentrates	$108.70	$115.39	$104.92	$88.30
Sphalerite concentrates	$42.52	$52.70	$48.03	$39.88

The lead and zinc deposits of Kansas, so far as developed, are limited to Cherokee County, in the southeastern part of the State. They form the western extension of the ore deposits of the Joplin region and display the general characteristics shown in that region, except that here typical sheet-ground deposits have not been extensively developed.

It is difficult to ascertain the production for early years or to segregate the Kansas ores from those produced in the Missouri portion of the Joplin region. If to the figures for 1886 to 1903, published by the Kansas Geological Survey,[2] are added those for 1904 to 1927, published in Mineral Resources of the United States, a total of 2,587,258 tons of zinc concentrates and 397,788 tons of lead concentrates is shown as the approximate production of Kansas from 1886 to 1927. About 70 mines, of which 50 are in the Blue Mound-Baxter area, shipped lead or zinc in 1927.

The older mining area at Lawton and Badger-Peacock produced no zinc or lead in 1927, and nearly all the production from Kansas came from the Blue Mound-Baxter district, an extension of the Miami field, and from the Waco camp, on the Kansas-Missouri State line. The Crestline district output of zinc concentrates was 1,768 tons less in 1927 than in 1926, that of Blue Mound-Baxter 25,176 tons less, and that of Waco (Kansas only) 4,041 tons less; the total decrease in zinc concentrates from Kansas in 1927 was 31,419 tons.

Shipments of galena from Kansas mines declined about 1,000 tons; Crestline was the only camp which shipped more galena in 1927 than in 1926.

Crestline district.—The production in the Crestline district, including shipments of galena and sphalerite from mines west of Badger, was 3,181 tons of galena and 6,640 tons of sphalerite in 1927, compared with 2,495 tons of galena and 8,408 tons of sphalerite in 1926.

The Crutchfield mine and mill of the Eagle-Picher Lead Co. were active all year. Much drilling and underground development was done, and the output was large. This property again contributed more than half of the lead concentrates shipped from the district, producing about 1 ton of lead to 2 of zinc. The output of the Andrew Bros. mine was largely galena concentrates, as was the output from the Morris & Babb, Thornton, and Dutch Boy mines. The property of the Crestline Products & Service Co. shipped some galena and had the largest yield of blende concentrates in the district in 1927; the Ellis mine of the Crestline company was equipped with a 300-ton plant and operated part of the year. The Dutch Boy Mining Co. completed a new 200-ton mill on the Moore land in December; this mill was operated for about a month. The recovery was about 2 tons of lead to 1 of zinc. Virtually all the lands in the vicinity of producing properties are under lease, but a comparatively small amount of drilling was done in 1927.

Lawton-Waco district.—The output of the Lawton-Waco district came from the mines near Waco, as the one property at Lawton—that of the Eastern Lead & Zinc Co.—was idle. The total output of the Waco district, which lies partly in Missouri and partly in Kansas, was 25,622 tons of sphalerite and 168 tons of galena in 1927 as compared with 33,737 tons of sphalerite and 90 tons of galena in 1926. The production of the Kansas part of the district was 17,669 tons of sphalerite in 1927, as compared with 21,710 tons of sphalerite and 15 tons of galena in 1926. The chief producing mines in the Kansas part of the district in 1927 were the Butte-Kansas and the Acme, bought by the Missouri-Kansas Zinc Corporation early in the year. The Dayton Milling Co. ran on tailings. Three shafts were operated by the corporation in ore at 220 to 300 feet. The Butte-Kansas mill has a capacity of 500 tons a shift. At the Acme ore was mined at the 200-foot level and from a deposit at 285 to 300 feet. The Acme mill is a modern 500-ton plant designed to handle the ore which is now coming largely from the lower levels. Much new equipment, including Marcy Ball mills and a float plant, was added to the mills. The tailing mill and sludge plant of 150 tons capacity at Barnsdall No. 3 made a satisfactory recovery from the material treated. The 300-ton mill of the Grasselli Mining Corporation ran most of the year on ore from the 200-foot level. This plant was closed early in 1928 and is said to be under a drilling option to the St. Louis Smelting & Refining Co., which has extensive holdings of leases along the Missouri-Kansas line. The Kansas Exploration (Inc.) did considerable drilling on the Grasselli property in 1927, but no mill was built.

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[2] Haworth, Erasmus, and others, History, Geography, and Metallurgy of Galena-Joplin Lead and Zinc: Univ. Kansas Geol. Survey, vol. 8, 1904.

Galena district.—The production of lead concentrates in the Galena district was 207 tons of galena and 154 tons of lead carbonate, as compared with 292 tons of galena and 198 tons of lead carbonate in 1926. There were small shipments of sphalerite concentrates, 140 tons in all, derived from one mine in the southwest part of the district. The galena was derived from clean-ups or from shallow mining, as the mines are flooded and no pumping was done in the years 1922 to 1927.

The Shoal Creek Mining Co., on the Connor land, was the producer of sphalerite. Lessees on the Bonanza, Illinois, Empire, and Templar lands shipped small quantities of galena and lead carbonates. Hand jigs were used to clean much of the ore, and the only mill active was that of the McKinney Mining Co. The cut-ground area is large, and most of the old mines are connected underground, so that few of the mines can be worked below the water level until the entire district is unwatered, which is not a probable development with ore at present price levels. The D. A. mine on the Wyandotte land was idle in 1927; it has since been sold to the Cygni Mining Co., who will move the mill from the old Log Cabin mine at Duenweg, Mo., to the D. A. mine.

Blue Mound-Baxter Springs district.—There was virtually no drilling in the north of Cherokee County, but a number of drill rigs were busy around Baxter Springs and on the road between Baxter Springs and Blue Mound. No drilling was done near Melrose, 6 miles west of the westernmost producing properties in Kansas. No new mills were finished for milling the deeper run of ore near Baxter Springs in 1927. Bodies of ore were drilled out ready for mining, shafts were sunk, and drifting was done. Operators were in no hurry to add to the output of concentrates, which already exceeded the consumption.

The St. Louis Smelting & Refining Co. continued drilling and drifting its large holdings near Baxter Springs, but no contract for a mill was made until 1928. The Commerce Mining & Royalty Co.

has the Paxton lease ready for a mill of larger capacity. Several shafts were sunk at the Leopard mine of the Velie Mines Corporation, and the construction of a 500-ton mill was begun. This mill was ready for operation early in 1928. Much new equipment was installed at the Hartley mine by the Interstate Zinc & Lead Co., and the capacity of the plant was increased from 300 to 800 tons. A Symons gyratory crusher was installed, and the mill was completely remodeled. An innovation at this mill is a picking belt to reduce the quantity of waste rock sent to the crushers.

The new mill on the western part of the Empire Development Co. lease is milling much higher grade ore than that treated at the old plant, which was on the eastern part of the lease and was burned in 1927.

The production of galena in the Baxter-Blue Mound area in 1927 was nearly as large as that of 1926, notwithstanding the larger decrease in the quantity of sphalerite shipped. This fact was due almost entirely to the unusually rich dirt containing a large percentage of galena mined at the Little and Eastside mines. The shipments of galena from these two mines were probably greater than those from any other individual mines in the Joplin region.

New concentrating plants were erected by the Cortez King Brand Mining Co. (Sonny Boy mine, 250 tons), the Empire Development Co. (250 tons), and Matthiessen & Hegeler Zinc Co. (250 tons). A tailing mill was erected by the Golden Rod Mining & Smelting Co. at the old Peru mine.

The mines that shipped more than 500 tons each of galena in 1927 were the Blue Mound, Northern, Consolidated No. 10, Wilbur, Little Robinson, Eastside (or Monarch), Webber, King Brand, Lawyers, Black Eagle, Muncie, Consolidated No. 14, and Big John.

The mines that shipped more than 3,000 tons each of sphalerite in 1927 were the Barr, West Side, Webber, Wilbur, Hartley, King Brand, Boska, Lucky Jew, Peru, Black Eagle, Cherokee, Chubb, Muncie, Lawyers, Bendelari, Kansas Exploration (Jarrett), Kansouri (Federal), Northern, Consolidated No. 10, Robinson, Consolidated No. 14, Blue Mound, Little, and Eastside (or Monarch).

Most of the output in 1927, as in many years past, came from mines north and northwest of the Picher area and close to the State line; mines and mills north of Hockerville and east and north of Blue Mound produced 3,522 tons of galena and 28,663 tons of sphalerite in 1927.

The shipments of concentrates from the entire Blue Mound-Baxter area in 1927 amounted to 32,080 tons of galena and 187,239 tons of sphalerite, compared with 33,764 tons of galena and 212,415 tons of sphalerite in 1926. The average lead content of the galena sold in 1927 was 78.6 per cent, and the zinc content of the sphalerite was 58.7 per cent. The ore (tailings excluded) milled in 1927 yielded 6.33 per cent in concentrates, compared with 6.11 in 1926, and at some mines the recovery was more than 10 per cent. About 72 per cent of the zinc and 89 per cent of the lead shipped from the district came from mines west and northwest of Blue Mound.

The producing properties in the area west and northwest of Blue Mound were the Tri State Zinc Co. (Blue Diamond), Blue Mound (Century Zinc Co.), Consolidated Nos. 7, 10, and 14, Wilbur, Northern, Vinegar Hill (Barr), Webber, West Side, Eastside (or Monarch), Early Bird, Southern, Tar Creek, Chubb, Little Robinson, Cherokee, Little, and Lucky Jew mines of Eagle-Picher, Black Eagle No. 2, Kansouri (Federal), Fox, Bendelari, Big John, Lawyers (Nos. 1 and 2), Boska, King Brand, Muncie, and Jarrett (Federal). The producing properties north of Hockerville and Zincville and east and north of Blue Mound were the Euterpe, Hartley, Harrington, Empire, Independence, Liza Jane, Kansas Line, Homestake (Federal), Brewster (Barnsdall No. 6), Hanenkratt, Peru, Connico, Racetrack, Clara Jane, Sonny Boy, Vantage Nos. 3 and 4, Matthiessen & Hegeler, and C. & H. Milling Co.

Flotation units with ball or rod mills were installed in 1927 at the Lawyers No. 1, Early Bird, Black Eagle tailing mill, Tri State Reclamation Co. (Homestake tailings), and Golden Rod Mining & Smelting Co. (Peru tailings). After the mill at the Tar Creek mine was burned in 1927 the mine was purchased by the Federal Mining & Smelting Co., and the ore will be treated at the Muncie mill.

Commonwealth No. 2 mine, which was sold to the Western Mining Co., was idle in 1927. Vantage No. 3, operated in 1927 by the Madison Mining Co., was sold to the Century Zinc Co. and Vantage No. 5 was sold to A. M. Braemar.

KENTUCKY

By J. P. Dunlop

Lead and zinc deposits occur in both central and western Kentucky. The central districts have not reported any shipments of lead or zinc for more than 20 years. The deposits in the fluorspar region of western Kentucky are chiefly in Crittenden, Caldwell, and Livingston Counties and form a continuation of those in the southern Illinois lead and zinc region.

Considerable quantities of galena ores have been produced in former years, but at present lead is obtained solely as a by-product in the recovery and concentration of fluorspar, which is the principal economic mineral. The galena recovered is argentiferous, and its silver content ranges from a very small quantity to more than 3 ounces a ton, but no recovery of this silver content has been reported by the smelters for many years.

Mine production of lead and zinc in Kentucky, 1918–1927

Year	Lead concentrates (galena)		Zinc concentrates				Metal content			
			Sphalerite		Zinc carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	255	$21, 066	--------	----------	927	$30, 390	185	$26, 270	315	$57, 330
1919	120	7, 250	--------	----------	120	3, 600	86	9, 116	36	5, 256
1920	172	12, 295	--------	----------	25	750	122	19, 520	9	1, 458
1921	100	3, 693	--------	----------	621	19, 800	69	6, 210	220	22, 000
1922	132	8, 365	--------	----------	419	8, 373	92	10, 120	142	16, 188
1923	78	6, 152	--------	----------	850	17, 925	53	7, 420	270	36, 720
1924	259	22, 908	--------	----------	1, 494	37, 000	175	28, 000	492	63, 960
1925	251	23, 619	--------	----------	1, 217	29, 740	152	26, 448	429	65, 208
1926	92	7, 537	582	$17, 471	4, 478	116, 417	58	9, 280	1, 838	275, 700
1927	241	14, 070	352	5, 392	2, 136	46, 514	139	17, 514	860	110, 080

The average lead content of galena concentrates in 1927 was 59 per cent. The total value of the lead and zinc concentrates shipped from Kentucky mines was $65,976, compared with $141,425 in 1926.

The sellers of galena concentrates in 1927 were the Franklin Fluorspar Co., Eagle Fluor Spar Co., and the Lafayette Fluorspar Co. The Lafayette Fluorspar Co.'s 75-ton mill was equipped with Richards jigs for the recovery of galena. The Zinc & Spar Co. operated the Hudson mine, near Salem, Livingston County. The zinc carbonate ore and the zinc blende of 51 per cent grade came from workings 95 to 150 feet in depth and were treated in log washers and by jigs and tables before shipment. The Sheridan Zinc & Mining Co. operated two log washers on zinc carbonate ores mined through two shafts. This company was the largest producer of zinc carbonate concentrates in the Eastern and Central States.

MICHIGAN

By H. M. Meyer

The mine production of copper in Michigan in 1927 was 177,537,775 pounds from 8,046,334 tons of "rock," a recovery of 22 pounds of copper from a ton of rock; the output of silver was 97,193 ounces. Less silver but more copper was produced than in 1926. The total calculated value of the two metals in 1927 was $23,312,558, a decrease from 1926 due largely to the lower average prices.

Tables showing the mine output of silver and copper in Michigan during the past seven years follow:

Mine production of silver and copper in Michigan, 1921–1927 [1]

Year	Silver (fine ounces)	Copper [2]			Concentrate ("mineral") [3]		Ore [4] ("rock") (short tons)
		Pounds	Yield				
			Pounds per ton of ore ("rock")	Percentage	Pounds	Yield (per cent)	
1921	310,727	86,370,028	23.9	1.19	148,024,931	58.4	3,610,648
1922	376,990	121,712,365	24.6	1.23	193,984,975	62.7	4,952,264
1923	223,997	138,304,080	25.8	1.29	220,055,091	62.8	5,363,160
1924	130,381	135,662,605	25.3	1.26	213,779,365	63.5	5,372,572
1925	139,499	155,157,488	22.0	1.10	241,056,386	64.4	7,036,751
1926	105,242	175,381,565	23.0	1.15	272,365,636	64.4	7,641,682
1927	97,193	177,537,775	22.1	1.10	275,460,828	64.5	8,046,334

[1] The figures are based on the actual recovery of copper from "mineral" smelted and the estimated recovery from "mineral" that was not smelted during the year.

[2] Includes copper from sands.

[3] Includes "mineral" from sands.

[4] Includes sands.

Value of silver and copper produced in Michigan mines, 1921–1927

Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")	
1921	$310,727	$11,141,734	$3.09	$11,452,461
1922	376,990	16,431,169	3.32	16,808,159
1923	183,678	20,330,700	3.79	20,514,378
1924	87,355	17,771,801	3.31	17,859,156
1925	96,812	22,032,363	3.13	22,129,175
1926	65,671	24,553,419	3.21	24,619,090
1927	55,109	23,257,449	2.89	23,312,558

At the request of the mine operators of the Michigan district, A. W. Fahrenwald, ore-dressing engineer of the Bureau of Mines, was detailed by the bureau to study the present milling practice in the copper district of Michigan in cooperation with the Michigan College of Mines and Technology. Work was actively begun in January, 1928, and results thus far promise a substantial increase in recovery of copper and a notable reduction in production costs. The amygdaloid ores, the predominant ores of the district, are now milled by straight gravity concentration methods, resulting in considerable metal losses. The present study indicates that these ores may be successfully treated by flotation.

F. G. Pardee, State mine appraiser of Michigan, has published data covering the cost of copper production in Michigan in 1927. The average cost per pound for the district is given as 11.4409 cents and the average selling price as 13.2801 cents, indicating a profit of 1.8392 cents a pound for Michigan copper in 1927, compared with 2.35 cents a pound in 1926 and 1.76 cents a pound in 1925. The details of the cost in 1927 are shown in the following table taken from Pardee's report:

Average cost per pound of Michigan copper production in 1927

	Cents per pound
General expense:	
General property tax	0. 4875
State corporation tax	. 0464
Depreciation	1. 2452
General office	. 1293
Other general expense	. 4739
	2. 3823
Mining cost:	
Labor	4. 0946
Supplies	2. 4850
	6. 5796
Treatment cost:	
Transportation (rock to mill)	. 3577
Concentrating	. 9872
Transportation to smelter	. 0396
Smelting and refining	. 7201
	2. 1046
Selling and delivery expense	. 4173
Gross cost	11. 4838
Credit for silver	. 0511
Net cost	11. 4409
Average price of copper	13. 2801
Average profit	1. 8392

The valuations of the copper mines as shown in Pardee's report are as follows:

Houghton County:	
Calumet & Hecla Consolidated Copper Co.—	
Ahmeek mill and railroad	$800, 000
Centennial	40, 000
Calumet & Hecla conglomerate	1, 700, 000
Osceola	765, 000
North Kearsarge	300, 000
Reclamation	9, 550, 000
	13, 155, 000

Houghton County—Continued.	
Copper Range Co.—	
Champion mine	$2, 550, 000
Baltic mine	175, 000
Trimountain	225, 000
	2, 950, 000
Isle Royale Copper Co	1, 250, 000
Quincy Mining Co. (including railroad)	800, 000
Arcadian Consolidated Copper Co	110, 000
Franklin Mining Co	100, 000
Mayflower-Old Colony Copper Co	80, 000
Hancock Consolidated Copper Co	49, 000
La Salle Copper Co	80, 000
Superior Copper Co	20, 000
Winona Copper Co	65, 000
Total Houghton County	18, 659, 000
Keweenaw County:	
Calumet & Hecla Consolidated Copper Co.—	
Cliff & Phoenix	30, 000
Ahmeek & Allouez	6, 000, 000
Mohawk Mining Co	2, 030, 000
Seneca Copper Mining Co	875, 000
Total Keweenaw County	8, 935, 000
Grand total Houghton and Keweenaw Counties	27, 594, 000

The following data are abstracted from reports by the companies to their stockholders:

In 1927 the Calumet & Hecla Consolidated Copper Co. produced from its mines 80,043,000 pounds of copper at an average cost sold (not including depreciation or depletion) of 10.45 cents a pound. During 1927 the reclamation plants at Lake Linden and Hubbell produced 28,717,000 pounds of copper at an average cost sold of 6.63 cents a pound. Comparative figures for 1926 are 73,297,924 pounds for the mines and 30,988,076 pounds for the reclamation plants. The average price received in 1927 for copper delivered was 13.25 cents a pound. The combined results of operations at the Tamarack plant, at Hubbell, and the Lake Linden plant for 1927 and since starting are shown in the following table:

		1927	Since starting
Material treated	short tons	3, 019, 000	18, 150, 000
Assay headings	per cent	0. 574	0. 669
Assay tailings	do	0. 093	0. 154
Refined copper	pounds	28, 717, 000	187, 392, 000
Refined copper per ton treated	do	9. 51	10. 32

Of the quantity shown for 1927, 6,791,000 pounds was from table treatment following grinding, 17,843,000 pounds from leaching, and 4,083,000 pounds from flotation. The Calumet mill treated 681,600 tons of conglomerate rock and 211,880 tons of Osceola amygdaloid rock and the Ahmeek mill 1,151,557 tons from the Kearsarge branch and 580,081 tons from the Osceola branch. Both mills were operated at capacity during the year. The smelter treated 98,876 tons of concentrates and mass. A new refining furnace, specially equipped for melting and refining large copper masses and for making billets and other irregular shapes, was completed and put into operation in July. A new melting furnace, having a capacity of 225 tons of mineral a day, is in process of construction; it is so situated that the molten metal from it will flow by gravity to either of the two large refining furnaces. Dividends totaling $4,011,004 were paid during the year.

Dewatering the old Cliff mine was continued and satisfactory progress reported. The company reports that wherever the levels are accessible examinations were made of geological conditions; the results substantially strengthen the theoretical bases upon which the exploration was undertaken.

The Isle Royale Copper Co. produced 11,391,338 pounds of refined copper from 465,100 tons of rock treated in 1927 at an average cost sold, but not including depreciation and depletion, of 11.55 cents a pound. The average price received for copper sold was 13.19 cents a pound. The company treated 447,747 tons of rock in 1926 to produce 11,017,000 pounds of copper, a recovery of 24.61 pounds to the ton. Rock hoisted in 1927 amounted to 593,594 tons, of which 21.65 per cent was discarded.

The Baltic, Champion, and Trimountain mines produced 22,661,553 pounds of refined copper in 1927, of which 14,612,090 pounds was for the Copper Range Co., as one-half of Champion's production belonged to St. Mary's Mineral Land Co. The cost per pound sold, not including depreciation and depletion, was 11.65 cents for the entire production and 12.02 cents a pound for that which belonged to the Copper Range Co. The total production in 1926 was 23,526,277 pounds of copper, of which 14,696,867 pounds belonged to the Copper Range Co. Although the average price received by the company in 1927, 13.42 cents a pound, was the lowest since 1921, the operating profits were the best since 1919, and the operating profit for the year was $508,796, compared with $385,103 in 1926. The Champion Copper Co. is exploring 5,000 acres of land lying to the north and west of the present Champion mine and owned equally by the Copper Range Co. and St. Mary's Mineral Land Co. The yield in copper per ton of rock stamped has been maintained, although the grade of rock mined is much lower than in former years. A rejection of 50 per cent of the rock mined is necessary to maintain the present yield. Figures of rock stamped and the recovery per ton, as shown in the following table, are quoted from the company report.

Rock stamped and copper recovered by the Champion, Trimountain, and Baltic mines, 1923–1927

Year	Rock stamped	Copper recovered per ton of rock stamped	Year	Rock stamped	Copper recovered per ton of rock stamped
	Short tons	*Pounds*		*Short tons*	*Pounds*
1923	593, 204	39. 74	1926	644, 648	36. 49
1924	615, 420	40. 80	1927	592, 045	38. 27
1925	591, 058	39. 38			

There was little change in the ore reserves at the mines as compared with 1926. The smelter treated 45,660 tons of mineral in 1927, an increase of more than 10,000 tons over 1926. The Copper Range Co. paid dividends totaling $394,755 in both 1927 and 1926.

The Mohawk Mining Co. hoisted 783,499 tons of rock in 1927 and stamped 759,878 tons which yielded 22,124,840 pounds of refined copper, or 29.116 pounds to the ton of rock stamped—the highest extraction made in many years. Financially, with the exception of the war period, the year was the most profitable one experienced by the company since the beginning of its operations. The success is reported due to the rich rock found in the ground tributary to shaft No. 6, which yielded 50 per cent of the rock stamped, to the efficiency and economy of those in charge of mining, and to the up-to-date plant. Dividends totaling $575,000 were paid in 1927.

The mine of the Quincy Mining Co. produced 413,000 tons of copper rock and mass in 1927, which yielded 9,718,662 pounds of refined copper, or 23.53 pounds to the ton. On July 13 a fire in No. 2 shaft at the fifty-third level caused a serious interruption to operations, necessitating closing the mine and sealing all connections with the surface in order to smother the fire. The shafts were reopened on August 10, and the few smoldering fires that remained were quickly extinguished. Concerning the fire, the company report states—

> The fire was a very serious matter, and seemingly it was the forerunner of further difficulties. The burning of the shaft timber left unsupported a large amount of rock filling adjacent to the shaft. This loose rock had been filled in the old stopes to support the openings left many years before, and left these openings unsupported, and they started to fail and cave, causing a serious accident at the fortieth level while recovering the shaft.
>
> This caving or rock failure, locally called "air blasts," seemingly spread to other sections, and a general failure of stope pillar supports started throughout the worked-out portions of the mine. This caving continued intermittently over a period of six months. Apparently all the stope pillars in the old worked-out portion of the mine that were left as far back as 20 years ago have crushed, and now may have about come to equilibrium and rest.

The Seneca Copper Mining Co. operated from January 1 to June 30, 1927, after which time it was idle.

MISSOURI

By J. P. Dunlop

The value of the mine production of silver, copper, lead, and zinc in Missouri in 1927 was $27,633,815, compared with $37,231,560 in 1926. The value of silver increased $76,478, the value of copper decreased $91,699, that of lead $8,078,160, and that of zinc $1,504,364. The mine production of lead in Missouri in 1927 was equivalent to 29.7 per cent of the smelter production of primary lead from domestic ores in the United States, compared with 30.4 per cent in 1926, and the mine production of zinc in Missouri was 3.2 per cent of the total primary zinc produced by smelters from domestic ores in 1927, compared with 4.3 per cent in 1926 and 22.7 per cent in 1917. About 70 mines and prospects in Missouri shipped lead or zinc concentrates in 1927.

Mine production of copper and silver in Missouri, 1918-1927

Year	Copper		Silver	
	Pounds	Value	Fine ounces	Value
1918	577,665	$142,683	46,939	$46,939
1919	1,617,200	300,799	90,401	101,249
1920	1,512,539	278,307	111,128	121,130
1921	137,591	17,749	69,902	69,902
1922	797,400	107,649	212,656	212,656
1923	202,556	29,776	177,270	145,361
1924	182,811	23,948	103,694	69,475
1925	12,100	1,718	83,340	57,838
1926	1,077,000	150,780	90,000	56,160
1927	451,000	59,081	233,931	132,638

The silver content of the lead ores is so small that it is disregarded in the assay and sale of the concentrates. For this reason the smelter reports must be relied on for the silver production. The quantity of silver produced in any year bears no direct ratio to the quantity of lead concentrates smelted during that year, because the silver content is so small that the silver bullion is stored and refined in batches. Over a series of years the concentrates average about 1 ounce of silver to the ton.

All of the copper produced in 1927 was derived from matte recovered in smelting lead ores; some development was done at copper mines, but no copper ore was shipped in 1927.

The value of the lead and zinc from concentrates produced in Missouri in 1927 was $27,442,096, a decrease of $9,582,524 from the value for 1926. The production of lead concentrates (of which all but 300 tons was galena) was 282,847 tons as compared with 305,767 tons in 1926. Of the total output in 1927, 279,441 tons was derived from southeastern and central Missouri, a decrease of 21,039 tons. The average lead content of the galena concentrates from these districts was 71.7 per cent in 1927, and the value of the galena concentrates per ton in 1927 was $83.60, as compared with $93.98 in 1926. The lead from southeastern and central Missouri concentrates in 1927 amounted to 196,251 tons, a decrease of 6,811 tons.

Shipments of galena concentrates from southwestern Missouri in 1927 were 3,106 tons, compared with 5,095 tons in 1926. The lead carbonate concentrates in 1927 amounted to 300 tons, an increase of 108 tons. The quantity of lead from southwestern Missouri, or the Missouri part of the Joplin region, was 2,509 tons, a decrease of 1,441 tons. The average lead content of the galena concentrates from southwestern Missouri in 1927 was 76.5 per cent, and the average value of the galena concentrates per ton was $83.26, or $22.48 less than in 1926.

The total quantity of zinc blende concentrates from Missouri mines in 1927 was 35,675 tons, a decrease of 11,798 tons, compared with 1926. Of the total in 1927, 27,285 tons came from southwestern Missouri. The average value received by the sellers of blende concentrates in southwestern Missouri in 1927 was $40.08 a ton, and the average zinc content reported was 58.3 per cent, compared with $49.01 and 59.6 per cent in 1926.

The quantity of zinc concentrates from southeastern Missouri is steadily increasing with the adoption of flotation. The shipments of sphalerite in 1927 were 8,390 tons of 57.5 per cent concentrates. The shipments will be much larger in 1928.

The zinc carbonate and silicate concentrates sold in 1927 amounted to 1,357 tons, or 2,312 tons less than in 1926. The output came entirely from southwestern Missouri. The average zinc content of these concentrates was 38.2 per cent, and the average value per ton was $26.26, compared with 39.3 per cent and $31.61 in 1926.

The value of lead concentrates from southeastern and central Missouri (which produced 99 per cent of the total for the State) was $23,360,294, or $4,879,439 less than in 1926, and the value of the zinc concentrates was $289,816, or $188,573 more than in 1926. The total value of the lead and zinc concentrates from southwestern Missouri was $1,405,694, compared with $2,884,007 in 1926.

The total quantity of ore or "dirt" mined and treated in Missouri in 1927 was 6,824,000 tons. The total amount received for all classes of lead and zinc concentrates sold in 1927 was $25,055,804, or an average of $3.67 to the ton of ore or "dirt" mined and treated.

In the following tables, showing the tenor of ore ("dirt") and concentrates from Missouri, it has been considered advisable to segregate ores of different nature. The disseminated lead ore of southeastern Missouri differs radically from the lead and zinc ores of the so-called "soft-ground" deposits of southwestern Missouri. Each class of ore has its peculiar problems of mining and ore dressing. The data are given for the ores mined in the Joplin region, but there have been no recoveries from "sheet ground" since 1921. In general, the tables reflect very closely the conditions of the industry.

Mine production of lead and zinc in Missouri in 1927, by districts

District	Lead concentrates				Zinc concentrates			
	Galena		Carbonate		Sphalerite		Silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Aurora and Wentworth	18	$1,440			1,386	$47,148	32	$770
Carl Junction	2	170			68	2,970		
Duenweg-Porto Rico	1,225	110,100			57	2,210	162	4,860
Granby	235	17,085			228	9,594	583	15,303
Joplin	559	45,072	200	$12,000	2,117	79,870	343	8,724
Oronogo	147	10,057						
Spring City-Spurgeon	73	6,192	100	6,000			207	4,925
Smithfield-Belleville	164	14,826			8,937	409,052		
Thoms Station	325	24,802			6,393	209,109		
Waco	168	12,803			7,953	330,185		
Webb City-Carterville	180	15,202			146	3,325		
Dade and Hickory Counties	10	850					30	1,050
	3,106	258,599	300	18,000	27,285	1,093,463	1,357	35,632
Central and southeastern Missouri	279,441	23,360,294			8,390	289,816		
	282,547	23,618,893	300	18,000	35,675	1,383,279	1,357	35,632
Total, 1926	305,575	28,778,496	192	15,143	47,473	2,315,362	3,669	115,982

Mine production of lead and zinc in Missouri in 1927, by districts—Continued

District	Metal content[1]			
	Lead		Zinc	
	Short tons	Value	Short tons	Value
Aurora and Wentworth	12	$1, 512	694	$88, 832
Carl Junction	1	126	35	4, 480
Duenweg-Porto Rico	959	120, 834	87	11, 136
Granby	159	20, 034	299	38, 272
Joplin	536	67, 536	1, 179	150, 912
Oronogo	101	12, 726		
Spring City-Spurgeon	114	14, 364	71	9, 088
Smithfield-Belleville	125	15, 750	4, 876	624, 128
Thoms Station	235	29, 610	2, 925	374, 400
Waco	125	15, 750	4, 253	544, 384
Webb City-Carterville	134	16, 884	63	8, 064
Dade and Hickory Counties	8	1, 008	10	1, 280
	2, 509	316, 134	14, 492	1, 854, 976
Central and southeastern Missouri	196, 251	24, 727, 626	4, 245	543, 360
	198, 760	25, 043, 760	18, 737	2, 398, 336
Total, 1926	207, 012	33, 121, 920	26, 018	3, 902, 700

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in southwestern Missouri, 1924–1927

	1924	1925	1926	1927
Total ore ... short tons	459, 100	662, 200	1, 025, 500	513, 800
Total concentrates in ore:				
Lead ... per cent	0. 65	0. 54	0. 52	0. 66
Zinc ... do	5. 38	4. 30	4. 76	5. 57
Metal content of ore:				
Lead ... do	0. 49	0. 41	0. 39	0. 50
Zinc ... do	3. 20	2. 54	2. 77	3. 21
Average lead content of galena concentrates ... do	76. 1	76. 8	76. 8	76. 5
Average lead content of lead carbonate concentrates ... do	60. 0	60. 0	60. 0	60. 0
Average zinc content of sphalerite concentrates ... do	60. 7	60. 8	59. 6	58. 3
Average zinc content of silicates and carbonates ... do	39. 3	38. 2	39. 3	38. 2
Average value per ton:				
Galena concentrates	$101. 31	$110. 51	$105. 74	$83. 26
Lead carbonate concentrates	$78. 71	$85. 73	$78. 87	$60. 00
Sphalerite concentrates	$41. 91	$54. 18	$49. 01	$40. 08
Zinc silicates and carbonates	$24. 29	$30. 80	$31. 61	$26. 26

Tenor of lead ore and concentrates in southeastern Missouri disseminated-lead district, 1924–1927

	1924	1925	1926	1927
Total lead ore ... short tons	6, 059, 700	6, 209, 800	6, 261, 600	6, 310, 200
Galena concentrates in ore ... per cent	4. 83	5. 06	4. 80	4. 42
Lead content of ore ... do	3. 26	3. 43	3. 32	3. 17
Average lead content of galena concentrates ... do	67. 6	67. 6	69. 0	71. 7
Average value per ton of galena concentrates	$84. 55	$100. 91	$93. 98	$83. 62

Mineral Resources for 1914, Part I, pages 72 to 77 and 97 to 100, gave a brief history of lead and zinc mining in the southeastern Missouri and Joplin regions, as well as data relating to the total lead and zinc production, the mining and milling practice, the character of the ore and concentrates, and the methods of selling them.

SOUTHWESTERN MISSOURI

Area and production.—The southwestern Missouri lead and zinc areas include the largest part of the Joplin region, the remainder lying in southeastern Kansas and northeastern Oklahoma.

Lead and zinc concentrates produced in the Missouri part of the Joplin region, 1907–1927

	Short tons	Value	
		Total	Average
Lead concentrates	459, 139	$29, 686, 390	$64. 66
Sphalerite concentrates	2, 897, 517	147, 224, 142	50. 81
Zinc carbonate and silicate concentrates	303, 803	9, 395, 595	30. 93
	3, 660, 459	186, 306, 127	----------

Prices.—The following quoted base prices apply not only to southwestern Missouri but also to all the mines in Oklahoma and Kansas that are in the Joplin region. The high-grade zinc concentrates containing less than 0.20 per cent of lead, of which there were about 65,000 or 70,000 tons in 1927, brought a base price of $1 to $2 above the quoted price. Part of the flotation concentrates produced were mixed with jig and table concentrates, and part were sold as "all flotation concentrates." The latter, if they contained above 55 per cent of zinc, brought $3 a ton less than jig and table concentrates; lower-grade flotation concentrates were subject to an even higher penalty. Attempts have been made to abolish the premium on lead-free or nearly lead-free zinc concentrates; no premium was paid for several weeks, but the limited supply of high-grade concentrates resulted in the restoration of a premium of at least $1 a ton. The average quoted base prices for 60 per cent sphalerite were highest in January and March, 1927, and lowest in November and December. The quoted price the first week in January was $45, but it slumped to $42 at the end of the month. In February the price ranged from $42 to $44. In March prices were steady at $45. In April prices steadily declined to $40 and were still lower at $39 and $38 in May. In June prices stiffened to $41, and the upward movement continued during July with $43 the peak quotation. Quoted prices then began to decline again, $42 being the highest price in August. Still lower prices prevailed in September, with the lowest price, $38, at the end of the month. At the end of October prices declined to $37 and early in November to $35. The price at the end of November and for the first part of December was $37, then the market weakened and the price dropped first to $36 and then to $35, the closing quotation for 1927.

No base prices were quoted for zinc silicate in 1927, and there was little demand for this ore. The output in 1927 was about one-third that of 1926, and the meager and desultory production did not interest the ore buyers. Most of the shipments were from the American mill at Granby, the Buxton & Durfee mill at Joplin, and the Joalmo mill at Duenweg. There was no demand for chunk or hand-cobbed zinc silicate.

In 1927, as in 1926, the quoted price for galena carrying 80 per cent of lead showed wide variations, ranging from a high of $100 a ton in March to a low of $75 in July. During the first two weeks in January it was $95 a ton and at the end of January $90. In February it advanced to $92.50. In March prices reached the highest point of the year, $100 prevailing most of the month. In April the market was unsteady and downward, the prices quoted being from $96 to $90. The decline continued during May and June until the price reached $78. There was a further decline to $75 early in July, but a quick recovery at the end of the month. The August price advanced as high as $87.50. During September, October, and November the price was stable at $80, and the prevailing price in December was $85.

Average prices per ton paid for sphalerite, and zinc and lead concentrates in southwestern Missouri, 1919–1927

	1919	1920	1921	1922	1923	1924	1925	1926	1927
Sphalerite	$40.67	$45.79	$25.18	$31.91	$40.52	$41.91	$54.18	$49.01	$40.08
Zinc silicate or carbonate concentrates	27.30	35.50	10.57	21.25	26.57	24.29	30.80	31.61	26.26
Galena concentrates	66.82	97.84	50.15	69.44	83.40	101.31	110.51	105.74	83.26

General conditions.—Only a few new properties were worked, and the output from the Missouri part of the Waco district continued to decrease. In southwestern Missouri there was a decrease of 1,989 tons of galena, 17,887 tons of sphalerite, and 2,312 tons of zinc silicate and carbonate. Some drilling was done at Granby, Smithfield, Waco, Thoms Station-Neck City, Spring City, Joplin, and other districts, and some bodies of ore were found. Drilling exploration was much less than in 1926, many leases were relinquished, and several mines and mills operated early in 1927 were shut down temporarily or abandoned late in 1927.

Some of the larger operators purchased fees on land that they desired to drill and hold for future operations, especially in sheet ground which does not yield enough ore for profitable mining at present prices unless it contains considerable galena. The output from southwestern Missouri will be even less in 1928 if the present price for ore continues. Mines near Smithfield and along the Kansas-Missouri State line yielded two-thirds of the output of blende from Missouri in 1927.

The Missouri part of the Waco district produced 22 per cent of the sphalerite shipped from Missouri in 1927, compared with 25 per cent in 1926, 47 per cent in 1925, and nearly 90 per cent in 1924. The mines at Waco (in Missouri only) that contributed the 7,953 tons of sphalerite and 168 tons of galena in 1927 were the High Five, Barnsdall No. 2, and the properties of the Tri State Zinc (Inc.). The upper workings at the High Five mine caved and the mill was wrecked, so that the mine was only worked part of the year. The Universal and Tulsa Pittsburg mines were idle throughout 1927. The St. Louis Smelting & Refining Co. continued its drilling on various leases, but built no plant. A new shaft was sunk by the Tri State Zinc (Inc.), and the 400-ton mill was rebuilt and improved.

The largest output of sphalerite in Missouri was that of the Isherwood mine of the Kansas Exploration Co., which operated five shafts at levels about 140 feet deep; the mill has a capacity of 250 tons in 10 hours. The second largest shipper of sphalerite from southwestern Missouri in 1927 was the Grasselli Mining Corporation near Thoms Station; four shafts supplied ore for the 300-ton mill.

The Matthiessen & Hegeler Mining Co. operated on the old Napoleon ground and ran its 200-ton mill until November, when the property was abandoned.

At Duenweg the only producers of any importance were the Log Cabin Mining Co., the largest shipper of galena in 1927 and a producer of galena concentrates only, and the Joalmo Mining Co., which produced small quantities of blende and zinc silicate. The Log Cabin mine became too dangerous to work and was abandoned. A considerable number of small leases on the Granby land of the American Zinc, Lead & Smelting Co. at Granby yielded lead and zinc concentrates. The Federal Mining & Smelting Co., a large lessee of the Granby land, did not operate its mill in 1927, although it did considerable development work.

Only a few mines were active near Joplin in 1927, and a large part of the galena and zinc silicate was produced in small lots by miners working in old areas. The C. & S. Mining Co. (old Imperial) operated two shafts and a 200-ton mill near the Kansas-Missouri State line in the early part of 1927 and made good output of both lead and zinc. Other producers near Joplin in 1927 were the Riverside Mining Co. (250-ton mill), near Fillmore's bridge, and the Howe Mining Co., at Central City. The Buxton-Durfee mill at Joplin ran part time on purchased ore and concentrates. The Movokan Mining Co. built a new 200-ton mill east of Joplin and mined ore through a 145-foot shaft. The production was good for several weeks, but the mine was closed until blende prices are higher. The Admiralty Zinc Co. did development work on the Bankers land and was building a 200-ton mill. The only shipments in 1927 from Aurora were small quantities of galena and zinc silicate. The Pontiac Mining Co. shipped about two cars of sphalerite from Carl Junction before becoming bankrupt. At Oronogo several sublessees at the old Oronogo Circle mine gouged the workings and recovered galena by means of crude jigs. The St. Charles Mining Co. and several smaller operators recovered galena and zinc silicate near Spring City.

At Wentworth the Barbo Mining Co. steadily shipped lead-free sphalerite from its 200-ton mill and rebuilt the mill on an adjoining lease. Only scrapping and drilling were done in the old Webb City-Carterville and Oronogo camps, and a few carloads of sphalerite and galena concentrates were shipped. In the Spurgeon and Racine camps the production was scattered and small.

The Corry Mining Co., of Everton, in Dade County, shipped a car of zinc silicate, and the Cross Timbers mine, in Hickory County, shipped a little galena.

CENTRAL AND SOUTHEASTERN MISSOURI

A brief description of the ore deposits in central and southeastern Missouri is given in the chapter of this series for 1915.

Copper, nickel, and cobalt occur in the ore in considerable quantity near Fredericktown and in small quantity irregularly in nearly all deep mines. It is only near Fredericktown that the copper, nickel, and cobalt content of the ore has been the object of mining, yet a concentrate of these metals has been recovered as a table middling at several plants in other parts of the district.

In the disseminated-ore district the production increased rapidly after 1869 and is estimated by Buckley to have amounted to 1,202,607 tons of lead concentrates, valued at $59,869,354, for the period from 1869 to 1906, inclusive. The mine production of southeastern and central Missouri has been reported annually since 1907.

Mine production of lead and zinc concentrates in southeastern and central Missouri, 1907–1927

Year	Lead concentrates (galena)		Zinc concentrates			
			Sphalerite		Carbonate and silicate	
	Short tons	Value	Short tons	Value	Short tons	Value
1907–1917	2, 559, 494	$135, 999, 703	1, 003	$43, 852	9, 758	$218, 203
1918	271, 506	20, 507, 064	13	285	235	6, 845
1919	229, 687	11, 590, 977	----------	----------	231	6, 576
1920	242, 248	19, 799, 389	----------	----------	61	1, 910
1921	280, 358	11, 737, 400	----------	----------	----------	----------
1922	271, 294	14, 779, 869	----------	----------	----------	----------
1923	259, 320	19, 434, 633	----------	----------	----------	----------
1924	292, 604	24, 739, 819	----------	----------	----------	----------
1925	314, 403	31, 727, 170	----------	----------	----------	----------
1926	300, 480	28, 239, 733	2, 301	101, 243	----------	----------
1927	279, 441	23, 360, 294	8, 390	289, 816	----------	----------

The output of silver in Missouri in 1927 was derived from refining pig lead or from copper matte or zinc concentrates recovered in milling or smelting lead ores.

The lead ore mined in the disseminated-lead district in 1927, amounting to 6,310,200 tons, yielded 4.42 per cent of lead concentrates which averaged 71.7 per cent of lead. The average value per ton of lead concentrates was $83.62, compared with $93.98 in 1926; the output of galena concentrates was 279,042 tons, compared with 300,400 tons in 1926. As several of the large producers not only mine but also smelt their lead concentrates, the values given for concentrates are to a certain extent arbitrary. The galena concentrates produced in the southwestern Missouri region, which contain a higher lead content, are sold mainly on bids from purchasers, and the values for those concentrates are not comparable with values given for concentrates of the disseminated-lead district.

Analyses of ores mined in the disseminated-lead district in southeastern Missouri and of the various grades of resulting concentrates are given in Mineral Resources for 1919 and 1920.

There were no shipments of zinc carbonate from southeastern Missouri during 1927, but there was a greatly increased output of sphalerite from the flotation plant of the St. Joseph Lead Co. Large quantities of zinc middlings from old operations are available for treatment at other plants in the future, and in some mines the quantity of zinc contained in the lead ore is greater than in ores formerly mined. Flotation will result in the recovery of much of this zinc; in consequence shipments of zinc concentrates from southeastern Missouri will increase steadily. An average assay of the sphalerite concentrates shipped in 1927 is as follows: Zinc, 57.5 per cent; copper, 0.1 per cent; iron, 2 per cent; calcium oxide, 1.3 per cent; magnesium oxide, 1 per cent; sulphur, 32 per cent; lead, 3 per cent; cadmium, 1 per cent; carbon dioxide, 2 per cent; and silver, 20 ounces a ton.

An assay made by Bruce Williams, of Joplin, of some stored zinc middlings of the Desloge Consolidated Lead Co. showed the following: Zinc, 27.10 per cent; iron, 6.70 per cent; lead, 17.75 per cent; lime, 7.50 per cent; copper, 0.015 per cent; cadmium, 0.45 per cent; and silver, 9.40 ounces a ton. As it would take slightly more than 2 tons of middlings to yield a ton of zinc concentrates, the silver content of the concentrates would be approximately the same as in those shipped by the St. Joseph Lead Co. in 1927.

It is apparent from the assays that the silver content of the zinc concentrates is unusually high—much higher in fact than in the bulk of the zinc concentrates marketed from Western States. In Utah and Colorado the lead concentrates contain much larger quantities of silver than the zinc concentrates. In southeastern Missouri the lead concentrates do not carry more than an average of 1 ounce of silver to a ton, whereas the sphalerite marketed and the middlings in stock average about 20 ounces of silver to a ton. Thus the lower the lead content of the zinc concentrates the higher the silver content, and in Missouri, contrary to the western mine experience for many years, it is the zinc and not the lead that carries nearly all the silver.

The quantity of galena recovered in 1927 from shallow diggings in Washington and Jefferson Counties was only 64 tons; the ore, which occurs in association with barite, is mined in a small way and at odd times by the barite miners.

Frank Mayes shipped about 50 tons of galena obtained in washing the overburden removed in stripping an open-pit coal mine in Moniteau County.

About 10 cars of galena were recovered in 1927 by the Hattann Mining & Milling Co. from old tailings of the Katherine mine at Fredericktown. A flotation plant was built and operated until the end of the year.

Small sales of lead ore were made by T. F. Blount, of Fertile, and the Washington Land & Mining Co. Nearly all the lead produced in southeastern Missouri was mined by the National Lead Co., St. Joseph Lead Co., Desloge Consolidated Lead Co., and Annapolis Lead Co.

All the copper output of Missouri in 1927 was from the treatment of slags derived from the smelting of lead ores. Some development was done by S. C. Wilson in Shannon County, but the ore mined is being held until a mill can be erected. The Sutton mine, near Eminence in Shannon County, was also being developed, but no copper ore was shipped in 1927; some was shipped early in 1928.

In 1927 the St. Joseph Lead Co., from mines in southeastern Missouri, produced about 4,528,000 tons of ore, which yielded 208,380 tons of lead concentrates, and the smelter produced about 151,045 tons of pig lead. The company operated four concentrating plants with an aggregate capacity of 15,300 tons in 24 hours. The depth of the 18 shafts in operation ranged from 200 to 500 feet.

The National Lead Co. operated five shafts and a plant with a capacity of 3,500 tons.

The Desloge Consolidated Lead Co. finished remodeling the 2,000-ton plant and operated three shafts in 1927.

The Annapolis Lead Co. mine, in Iron County, was worked steadily and had a much larger output of galena in 1927 than in 1926.

The Ozark Tungsten Co. was operating at Silvermine, in Madison County. Old shafts were deepened, and drifting was done. A small mill was built, and some tungsten, lead, and zinc were recovered; no shipments were made in 1927.

OKLAHOMA

By J. P. Dunlop

Mine production of lead and zinc in Oklahoma in 1927, by districts

District	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content[1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Miami	62,866	$5,444,189	373,762	$14,262,461	48,171	$6,069,546	191,191	$24,472,448
Peoria			20	320			6	768
Quapaw and Sunnyside	4,578	407,834	30,446	1,213,185	3,509	442,134	15,414	1,972,992
	67,444	5,852,023	404,228	15,475,966	51,680	6,511,680	206,611	26,446,208
Total, 1926	90,625	9,692,169	531,695	24,406,164	69,704	11,152,640	272,567	40,885,050

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma in 1927

	Crude ore	Old tailings and slimes
Total ore, etc., milled...short tons	7,199,100	2,733,300
Total concentrates recovered:		
Galena...do	67,076	368
Sphalerite...do	356,415	47,793
Ratio of concentrates to ore, etc.:		
Lead...per cent	0.93	0.01
Zinc...do	4.95	1.75
Metal content of ore, etc.:		
Lead...do	0.73	0.01
Zinc...do	2.89	0.97
Average lead content of galena concentrates...do	78.2	68.0
Average zinc content of sphalerite concentrates...do	58.5	55.5
Average value per ton:		
Galena concentrates	$86.87	$68.58
Sphalerite concentrates	$38.93	$33.47

The following table gives the output of lead and zinc ore, old tailings, etc., for Oklahoma from 1924 to 1927:

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1924–1927

	1924	1925	1926	1927
Total ore, old tailings, and slimes milled in Oklahoma.......short tons..	8, 804, 000	10, 605, 200	10, 934, 000	9, 932, 400
Total concentrates in ore, etc.:				
Lead.......per cent..	1. 04	1. 01	0. 86	0. 68
Zinc.......do....	5. 76	5. 13	4. 95	4. 07
Metal content of ore, etc.:				
Lead.......do....	0. 83	0. 80	0. 65	0. 53
Zinc.......do....	3. 41	3. 01	2. 83	2. 36
Average lead content of galena concentrates.......do....	79. 2	78. 9	78. 5	78. 2
Average zinc content of sphalerite concentrates..do....	59. 2	58. 6	58. 1	58. 1
Average value per ton:				
Galena concentrates.......	$106. 68	$117. 13	$106. 95	$86. 77
Sphalerite concentrates.......	$40. 93	$50. 64	$45. 91	$38. 29

Mine production of lead and zinc concentrates in Oklahoma, 1891–1927, by districts

District	Lead concentrates (mainly galena)		Zinc concentrates			
			Sphalerite		Zinc silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value
Peoria.......	2, 206	$109, 163	220	$8, 289	2, 944	$76, 787
Quapaw and Sunnyside.......	17, 882	1, 687, 173	135, 770	6, 083, 744	164	2, 692
Miami.......	865, 768	78, 029, 725	4, 356, 496	188, 893, 910	....	....
Davis.......	....	....	558	27, 399	899	24, 592
	885, 856	79, 826, 061	4, 493, 044	195, 013, 342	4, 007	104, 071

Mineral Resources for 1914 contains a brief history of mining in the districts in Oklahoma and also the estimated total production of each district, by years.

The total quantity of lead and zinc concentrates shipped from Oklahoma in 1927 was 24 per cent less than in 1926, and the total value was 37 per cent less. The total value of the zinc concentrates was $8,930,198 less than in 1926 but greater than the value of any one year's production of any other State.

The lead and zinc deposits of northeastern Oklahoma, so far as known, are confined to Ottawa County and form the southwestern extension of the deposits in the Joplin region. There are three camps—Peoria, Quapaw-Sunnyside, and Miami—in which extensive mining has been done, and a fourth, the Sycamore Creek district, along the Seneca fault block 2 to 3 miles southwest of Seneca, Mo., in which considerable prospecting has been done and some ore mined. The lead and zinc deposits in southern Oklahoma are near Ravia, at the southeast end of the Arbuckle Mountains, and near Davis, Murray County, at the northwest end of the same range.

The quantity of ore and old tailings milled in Oklahoma decreased 1,001,600 tons in 1927, of which the total quantity milled by the old mines near Commerce and for mines near Quapaw and Sunnyside was less than 1 per cent, compared with 7 per cent in 1926. The value of the lead and zinc produced at mines in Oklahoma in 1927 was $32,957,888, compared with $52,037,690 in 1926. The lead from concentrates sold decreased from 69,704 to 51,680 tons and the zinc from 272,567 to 206,611 tons.

The average lead content of the concentrates produced decreased from 78.5 per cent in 1926 to 78.2 per cent in 1927. The average metal content of the sphalerite concentrates from the Miami ore increased from 51.8 per cent in 1912 to 58.6 per cent in 1925; the average was 58.1 per cent in both 1926 and 1927.

Oklahoma produced 63 per cent of the total output of both lead and zinc concentrates from the Joplin region in 1927. The Oklahoma shipments of sphalerite decreased 127,405 tons.

A history of the mining in the Miami district, including the output by years for 1908 to 1914 and the location of the mines and mills, was given in Mineral Resources for 1914. The reports for 1915 to 1926 contain full reviews of the production, new territory prospected, new mines opened, and new mills erected in those years. A brief description of the ore deposits in the Miami district is given in Mineral Resources for 1915.[3]

In 1927 about 135 mills in the Oklahoma part of the Miami field shipped 67,444 tons of galena concentrates and 404,208 tons of sphalerite concentrates. The average value of the galena concentrates decreased $20.18 a ton, and the average value of sphalerite concentrates, of which the quantity was nearly six times as great as that of galena shipped, decreased $7.62 a ton.

The striking feature in the Miami district in 1927 was the continued rapid increase in the installation of flotation equipment which is now used in nearly all mills in the district. More attention also was given to milling, and consequently the percentage of recovery from ore was greater. It is estimated that between 80 and 85 per cent of the metal is now being recovered. Many plants in the district utilized ball mills or rod mills for regrinding. Another feature was the rapid increase in the number of mills running tailings and the large increase in the quantity of old slimes and tailings re-treated. The quantity of this material increased from 960,600 tons in 1926 to 2,733,300 ton in 1927.

Some drilling was done on the western edge of the productive area; several mines were ready for mills, but none were built. The weekly output of concentrates decreased steadily in 1927. There were no labor troubles; the supply of labor was in excess of demand.

The total quantity of ore and tailings milled in the Miami part of the Joplin region in Oklahoma and Kansas in 1927 was about 13,772,200 tons. Each of 96 mines in this region made shipments of lead and zinc concentrates exceeding $100,000. Notwithstanding a much decreased rate of operation in 1927, more drill rigs and more shafts and milling plants were in operation in this small area than in any other district in the United States. Comparatively few mills, other than tailing mills, were built, but recoveries from ore by concentration were greatly increased by continued betterment of mill equipment and by the further use of flotation for slimes. There are now about 160 plants in the field equipped for flotation. The quantity of flotation concentrates being produced at the end of the year was about 2,500 to 2,700 tons weekly. The sphalerite recovered by flotation contains a considerable quantity that will assay 57 to 60 per cent zinc, although some runs as low as 48 per cent, and the average is probably about 55 per cent.

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[3] Siebenthal, C. E., Zinc: Mineral Resources of the United States, 1915, pt. 1, 1917, pp. 888–890.

In the Miami area in Oklahoma 2,733,300 tons of old tailings and slimes were re-treated in 1927, yielding mainly zinc concentrates (47,793 tons), of which the average zinc content was 55.5 per cent. The yield of zinc concentrates from tailings and slimes will again show an increase in 1928, but the output from crude ore will show a large decrease. The tailings yielded only 368 tons of galena, as very little galena is lost in milling the original ore. Many tailing plants were built in 1927, and an increased number of mills handling ore in previous years treated tailings or part ore and part tailings.

Although many mines were thought to have nearly exhausted their ore bodies three or four years ago, few have been abandoned. In 1927 some were making clean-ups and trimming pillars. By active prospecting most of the old properties found more ore or took up old stopes and discovered ore at lower levels. There will, however, be a steady increase in the number of worked-out mines in 1928 and 1929. Considerable ore was mined that yielded less than 4 per cent in concentrates; most of this ore, however, contained more than the usual proportion of lead and produced lead concentrates that were more than double the value of zinc concentrates produced.

Most of the mines or leases sold in 1927 were taken by operators of other mines in their district. Although operations were curtailed, nearly all of the larger operating companies, such as the Federal, Eagle-Picher, Kansas Explorations (Inc.), Golden Rod, Commerce, New Chicago, Consolidated, Vinegar Hill, Velie, American Zinc, and Anna Beaver, increased their holdings.

Near Hockerville and Zincville.—The Brewster mine was again much the largest producer in this area; the Beck mine ranked second (no lead was shipped from the Beck). The other leading producing mines were the Consolidated No. 3, Huttig No. 1, Imbau, and Scott. Smaller producing mines were the Huttig No. 2 (Beck lease), Dobson, Meteor, Blue Bonnett, Blue Bonnett (tailings), Weiss, Atzec, Mary Ann, Wade, Lucky Jenny, Duluth, Texas, Farmington, Theurer (tailings), Retriever (tailings), Ozark (tailings), Blue Ribbon, Barbee (tailings), and Crane Milling Co. (tailings).

The Huttig No. 1 was sold to the Eastern Lead & Zinc Co., who operated it in the fall of 1927 after making extensive improvements to the mill. The Blue Ribbon mine was sold to the Duluth Lead & Zinc Co., who doubled the capacity of the mill. The Wade mine was sold to Williams, Payne & Mosby. The Lucky Jenny was taken over by the United Zinc Smelting Co. The Texas mine lease, owned by the Vinegar Hill Zinc Co., was sold to the Dumarks Mining Co. More than 400,000 tons of old tailings and slimes were treated at plants operated on the Farmington, St. Louis Nos. 1 and 2, Huttig No. 1, Blue Bonnett, Santa Fe, and Black Eagle mines. The Scott mine was worked out and abandoned. A new 350-ton mill was built at the Atzec mine by the Century Zinc Co.

Near Quapaw and Sunnyside.—About 515,100 tons of ore and old tailings were milled in 1927, and the concentrates derived therefrom amounted to 4,578 tons of galena and 30,446 tons of blende. More than half of the galena and nearly 27 per cent of the blende was shipped from the Malsbury mine; several mines yielded blende with no appreciable quantity of lead. Three mines (including the

Malsbury) of the Century Zinc Co. shipped nearly one-half of the sphalerite and 80 per cent of the galena. Most of the remainder was the output of the Tulsa Lead & Zinc Co. and the Federal Mining & Smelting Co. (Davenport mill). Other producing mines in 1927 were the Donna Jane, Rainbow, Bingham, Martha B, American Prospecting, Vantage No. 2, and Campbell. The Century Zinc Co., after having completed a 450-ton mill on the Campbell lease in October, 1926, sank four shafts to the 175-foot level. After a short period of operation in 1927, Vantage No. 2 was sold by the United Zinc Smelting Corporation to Smith & Davis.

Near Century and Douthat.—Eighty-seven per cent of the sphalerite and 80 per cent of the galena shipped from properties in this area were produced by the Consolidated Lead & Zinc Co. (two mills), New Chicago Mines Corporation (two mills), Admiralty Zinc Co. (three mills), and Skelton Lead & Zinc Co. (three mills). Other producing mines were the Gish Mining Co. (old Missouri Mule), Ramage Mining Co., Childress Lead & Zinc Co., and Birthday Mining Co. Tailing mills active in 1927 were those of the Dudley Milling Co. (Admiralty lease), Century Milling Co. (Montreal lease), California Milling Co., and Moyer Milling Co. Old tailings were also run at New Chicago mills 1 and 2.

The quantity of old tailings reported as treated in 1927 was 683,100 tons, and the yield was 10,126 tons of sphalerite having an average zinc content of about 56 per cent.

Near Cardin and Tar River.—This area in the Miami field had the largest number of operated mines in 1927 and made much the largest shipments of concentrates. The largest shippers were the Golden Rod Mining & Smelting Co. (4 mills), Commerce Mining & Royalty Co. (7 mills), O. M. Bilharz Mining Co. (2 mills), Interstate Zinc & Lead Co. (1 mill), Velie Mine Corporation (1 mill), Anna Beaver Mine Co. (2 mills), Rialto Mining Corporation (1 mill), and Federal Mining & Smelting Co. (2 mills).

Other large producers of lead and zinc were the Crystal Mineral Trust, Pioneer Mining Co., L. & G. Mining Co. (Republic), Vinegar Hill Zinc Co. (Wilson), Quapaw Mining Corporation (Tom L.), Kitty Mining & Milling Co., Childress Lead & Zinc Co. (Southside), Foch Mining Co., Acme Lead & Zinc Co., Childress & Haggen Mining Co., Jack & Jill Mining Co., Domado Lead & Zinc Co., Kansas Explorations (Inc.) (Ritz), Dorothy Bill Mining Co., Tri State Mining Co., and American Zinc, Lead, & Smelting Co. (Douthat).

Tailings were run at mills owned by the O. M. Bilharz Mining Co., Consolidated Mining & Smelting Co. (No. 13), Commerce Mining & Royalty Co. (Blue Goose), L. & G. Mining Co., Kansas Explorations (Inc.) (Ritz), R. T. R. Milling Co., Canadian Mining & Development Co., and Moyer Milling Co.

The total quantity of old tailings and slimes treated in 1927 was 923,700 tons, and the shipments from tailings were 150 tons of galena concentrates and 17,786 tons of sphalerite concentrates averaging a little more than 55 per cent zinc content.

New tailing mills equipped with flotation machines were built by the O. M. Bilharz Mining Co. (300 tons) and the Federal Mining & Smelting Co. (200 tons).

The Kitty mine and mill were purchased by the Domado Lead & Zinc Co., and the old Black Hawk and Golden Rod No. 5 are now owned by the Golden Hawk Mining Co.

Near Picher.—From the area about Picher, which includes many of the older mines of the Miami district, the output of concentrates in 1927 was considerably less than in 1926, as the quantity of ore milled was smaller. The largest shipper was the Eagle-Picher Lead Co. (seven mills). Other large shippers were the Acme Lead & Zinc Co., United Zinc Smelting Corporation (Royal), White Mines Co., Mahutska Mining Co., Childress Lead & Zinc Co. (Whitebird), Commerce Mining & Royalty Co. (Grace Walker), Premier Zinc Co. (Premier and St. Joe), Federal Mining & Smelting Co. (Gordon), Consolidated Lead & Zinc Co. (La Salle and Piokee), Vantage Mining Co., Birthday Mining Co. (Leonora), Howe Mining Co., Commonwealth Mining Co., Oko Mine, Golden Rod Mining & Smelting Co. (Jefferson), Black Hawk Lead & Zinc Co., Cortez King Brand Mining Co. (New York and Cortez), Jeff City Mining Co., and American Zinc, Lead & Smelting Co. (Big Chief).

Old tailings and slimes were run by the Tri State Zinc Co. (White), Childress Lead & Zinc Co. (Whitebird), Consolidated Lead & Zinc Co. (Grace B), American Zinc, Lead & Smelting Co. (Big Chief), Oko Mine, Golden Rod Mining & Smelting Co. (Jefferson), Black Hawk Lead & Zinc Co., New Chicago Mines Corporation (No. 4), and the Just Right Milling Co. (Acme).

The estimated quantity of old tailings and slimes re-treated was 669,500 tons, from which were recovered 209 tons of galena concentrates and 11,438 tons of sphalerite concentrates (55.1 per cent zinc).

The White mine and mills were sold to the Inter-State Zinc Corporation about the middle of 1927.

The Vantage No. 1 mine was sold to the New Chicago Mines Corporation. All the crude ore from the Vantage, Premier, and St. Joe mines is now milled at the Premier mill, and the Vantage mill has been converted into a tailing plant. The Premier mill handles ore alone part of the time, but handles tailings also during the night shift.

A 200-ton tailing plant was erected to handle the tailings at the Old Chief mine; a good recovery was made during the year.

The quantity of ore, old tailings, and slimes milled in Oklahoma decreased from 10,934,000 tons in 1926 to 9,932,400 tons in 1927. The average zinc content of the sphalerite was 51.8 per cent in 1912, 59.2 per cent in 1924, 58.6 per cent in 1925, and 58.1 per cent in both 1926 and 1927. The separate assays reported in 1927 showed a zinc content of 40 to 62 per cent, but most of the blende assayed between 57 and 59 per cent. An assay of a composite sample of 8,445 samples of ore shipped in 1927 from the Miami-Blue Mound region, made by Bruce Williams, of Joplin, Mo., showed an average content of 57.6 per cent of zinc, 2.5 per cent of iron, 1.95 per cent of lead, and 0.56 per cent of cadmium. The average zinc assay, as computed from the reports of all the companies selling concentrates, was 58.1 per cent.

The recovery of concentrates from all the mines in Oklahoma averaged 1 ton of galena to about 6 tons of sphalerite. The proportion of galena concentrates recovered from the "dirt" mined showed wide variations in different mines, ranging from less than 1 ton of galena to 50 tons of sphalerite to 10 tons of galena to 1 ton of sphalerite. Only three mines reported no lead recovered.

The total shipments from those properties that may be properly classed as in the Tar River-Cardin-Douthat area, of which there were a greater number than in the other areas, amounted to 39,491 tons of galena and 228,778 tons of sphalerite. The percentage of concentrates recovered decreased from 5.74 to 4.69 per cent, and the quantity of concentrates shipped decreased 65,042 tons. About 5,725,000 tons of ore, etc., was milled, and the recovery in concentrates averaged about 0.69 per cent for galena and 4 per cent for sphalerite. The lower shipments and recoveries were due to the increase in old tailings treated. The proportion of galena to sphalerite recovered at all the mines in the vicinity of Douthat was 1 ton of galena to about 8 tons of sphalerite; in the Cardin-Tar River section the mines yielded 1 ton of galena to about 5 tons of sphalerite and in the Picher area 1 ton of galena to about 5.4 tons of sphalerite.

The territory east of Picher, near the Hockerville and Zincville (St Louis) camps, was less productive than in 1926, when the shipments from 24 mines and 4 tailing mills were 9,150 tons of galena and 88,088 tons of sphalerite; in 1927 the shipments from 24 mines and 4 tailing mills were 5,546 tons of galena and 54,835 tons of sphalerite, from 763,600 tons of ore and 417,000 tons of old tailings treated. The sphalerite averaged about 58 per cent in zinc content and the galena 78.7 per cent in lead content.

The production of the mines near Picher decreased. In 1926 the quantity of ore and old tailings milled was 2,870,400 tons, and the shipments were 28,264 tons of galena and 117,823 tons of sphalerite. In 1927 the quantity of ore and old tailings milled was 2,461,300 tons and the shipments were 16,672 tons of galena and 88,969 tons of sphalerite, or an average recovery of 4.29 per cent in concentrates. The zinc content of the sphalerite averaged about 57.9 per cent and the lead content of the galena 78.3 per cent.

At Commerce several old mines, including the Gordon McBee (worked by the Commerce Mining & Royalty Co.), Lost Trail, Cactus, and Miami, were operated in 1927. Shipments from Commerce were 1,157 tons of galena and 1,180 tons of sphalerite.

The only shipments from Peoria, the oldest mining camp in Oklahoma, reported in 1927 were small lots of zinc silicate purchased by the Eagle-Picher Lead Co.

WISCONSIN

By J. P. Dunlop

Mine production of lead and zinc in Wisconsin in 1927, by districts

District	Lead concentrates		Zinc concentrates				Metal content [1]			
			Sphalerite		Silicate and carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Benton-New Diggings	1,034	$94,103	55,267	$974,346	------	------	749	$94,374	14,510	$1,857,280
Cuba City	60	5,224	910	26,691	------	------	45	5,670	287	36,736
Dodgeville	84	5,964	1,433	39,400	------	------	58	7,308	481	61,568
Hazel Green	133	10,867	20,888	404,479	------	------	98	12,348	5,380	688,640
Highland	18	1,440	------	------	755	$13,473	13	1,638	217	27,776
Linden and Livingston	131	9,500	3,249	98,072	------	------	88	11,088	1,351	172,928
Platteville	74	6,584	4,300	93,650	------	------	55	6,930	1,260	161,280
Shullsburg	1,380	103,699	43,992	602,731	------	------	963	121,338	9,355	1,197,440
	2,914	237,381	130,039	2,239,369	755	13,473	2,069	260,694	32,841	4,203,648
Total, 1926	2,347	218,313	100,698	2,204,312	595	14,905	1,546	247,360	26,800	4,020,000

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[1] In calculating the metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1924–1927

	1924	1925	1926	1927
Total ore………short tons..	652, 000	1, 003, 700	1, 440, 300	1, 480, 800
Total concentrates in ore:				
Lead………per cent..	0. 27	0. 26	0. 16	0. 20
Zinc………do….	8. 49	7. 62	7. 03	8. 83
Metal content of ore:				
Lead………do….	0. 20	0. 19	0. 13	0. 14
Zinc………do….	2. 77	2. 53	2. 38	2. 79
Average lead content of galena concentrates………do….	73. 1	72. 8	67. 2	72. 4
Average zinc content of sphalerite concentrates………do….	32. 6	32. 8	33. 8	31. 6
Average zinc content of zinc carbonate concentrates………do….	33. 4	34. 1	32. 3	32. 7
Average value per ton:				
Galena concentrates………	$100. 11	$105. 62	$93. 02	$81. 46
Sphalerite concentrates………	$17. 59	$22. 66	$21. 89	$17. 22
Zinc carbonate concentrates………	$17. 25	$22. 51	$25. 05	$17. 85

The ore yields from 5 to more than 20 per cent of concentrates; the average recovery in concentrates increased from 7.19 per cent in 1926 to 9.03 in 1927. This increase is a reflection of the lower price received for concentrates.

The zinc carbonate ore, which is mined almost entirely in the Highland and Mineral Point districts, is purchased by the Mineral Point Zinc Co. and made into zinc oxide in the plant at Mineral Point, Wis. More carbonate ores were produced in 1927, and the sales were 755 tons, or 160 tons more than in 1926.

The metal content of the raw sphalerite concentrates shipped by the mines in 1927 ranged from 25 to 55 per cent, but more than 64 per cent of the concentrates sold ranged between 30 and 37 per cent, and 24 per cent of the total averaged about 25 per cent in zinc content. The zinc content of the roasted sphalerite concentrates shipped was 57 to 58 per cent.

The value of the mine output of lead and zinc in Wisconsin in 1927 was $4,464,342, compared with $4,267,360 in 1926. The lead concentrates sold increased from 2,347 tons in 1926 to 2,914 tons in 1927, and the sphalerite concentrates sold increased from 100,698 to 130,039 tons. The quantity of lead from galena concentrates was 523 tons more than in 1926. The zinc from sphalerite and zinc carbonate concentrates increased 6,041 tons.

Less development work was done than in 1926, and few new mines were opened.

About 75 per cent of the galena and 82 per cent of the sphalerite shipped were the output of the Vinegar Hill Zinc Co. and the Mineral Point Zinc Co., although about 21 mills were operated. Small quantities of galena and zinc carbonate were produced by many small operators.

The lead and zinc mines of Wisconsin are in Grant, Iowa, and Lafayette Counties and contain the most valuable part of the ore deposits of the upper Mississippi Valley region, a historical review of which is given in the Illinois section of this report in Mineral Resources for 1914. A detailed description of the Wisconsin lead and zinc districts and of the mines in each district to the year 1906 is given by Bain.[4] The development of the mines subsequent to Bain's report and the output of Wisconsin mines have been set forth in Mineral Resources since 1906.

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[4] Bain, H. F., Zinc and Lead Deposits of the Upper Mississippi Valley: U. S. Geol. Survey Bull. 294, 1906, pp. 81–148.

Roasting and electromagnetic separation have been utilized in the district for many years to produce a marketable zinc product. Comparatively few of the concentrating plants are equipped with roasters, but the larger mining interests own or control separating plants,[5] and nearly all the raw concentrates were roasted.

The roasting and separating plants operated in Wisconsin in 1927 were those of the National Zinc Separating Co., at Cuba City, and the Mineral Point Zinc Co., at Mineral Point. The shipments made came from about 40 mines, many of which were small and were operated spasmodically.

Sphalerite concentrates shipped in 1927 from mines in the upper Mississippi Valley region (Illinois and Wisconsin) amounted to 132,765 tons; all of this material except about 500 tons was treated at roasting and separating plants in Wisconsin. The average zinc content of the raw sphalerite concentrates from Wisconsin sold in 1927 was 31.6 per cent, and the average value per ton was $17.22, compared with 33.8 per cent and $21.89 in 1926.

The percentage of concentrates recovered from ore is much higher in Wisconsin than in the Joplin region, but the assay of the raw zinc concentrates shows 10 to 45 per cent less zinc content. The concentrates from the tables have a very high iron content, but this can be remedied by roasting; in consequence, more tailings have been rerun during the last four or five years than in all years prior to 1921.

Four of the mines owned or controlled by the Mineral Point Zinc Co. (the Booty, Champion, Longhorn, and Copeland) were worked in 1927. The Vinegar Hill Zinc Co. worked the Monmouth (abandoned in 1927) and Birkett mines at Hazel Green and the Mullen and James mines near Shullsburg; it also worked the Middie mine at Benton until the mine was leased to the Middie Mining Co. The larger mines and mills busy in 1927 were the Booty, Bull Moose, Longhorn, and Champion at New Diggings; the Middie, Cherry & Poppa, Ida Blende, and Badger at Benton; the Lucky Five at Dodgeville; the Monmouth at Hazel Green; the High Spot at Platteville; the Rule at Linden; and the James, Mullen, and Copeland at Shullsburg. Other shipments of concentrates were made from the Fox & Lee, C. Lawyer, and George Baker mills at Benton; Capitol Mining Co. at Cuba City; and Hazel Green at Hazel Green. The Paris Hill Mining Co. was developing the McCabe land by means of shafts and drifts, but no mill was built. Only development was accomplished at the Curwin mine. The Connecting Link mine made only a small output in 1927, and the equipment was sold. The Paquette mine near Shullsburg had a small output from a brief period of operation by R. A. Fox.

The only tailing mill active in 1927 was that of the Lawyer Bros. at the Winskill mine.

Nearly all the zinc carbonate ore was from small mines on Mineral Point Zinc Co. land at Highland. In addition to the zinc carbonate ore shipped, some mixed sphalerite and zinc carbonate and silicate ores, which were included with the sphalerite, were sold in 1927. Mines in the Shullsburg and New Diggings districts produced 75 per cent of the galena shipped in 1927. In December the Mineral Point Zinc Co. gave up the subleases of the American Zinc, Lead & Smelting Co. in the New Diggings district; the mines are to be abandoned by the lessees, and the mills are to be removed or sold.

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[5] Deutman, E. G., The Roasting and Magnetic Separation of Wisconsin Zinc Ores: Eng. and Min. Jour., June 28, 1919, pp. 1107-1111.

For descriptions of old mines, concentrating plants, and roasting plants in which no essential changes were made during 1927, the reader is referred to Mineral Resources for recent years.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By JAMES M. HILL [1]

SUMMARY

The total value of the mine production of gold, silver, copper, lead, and zinc in California in 1927 was $16,831,362, a decrease of 16 per cent as compared with 1926. The production of gold declined 2 per cent. The output of silver was 20 per cent less in quantity and 27 per cent less in value than in 1926. Production of copper decreased 19 per cent in quantity and 24 per cent in value. The output of lead decreased 66 per cent in quantity and 74 per cent in value. Zinc produced in 1927 was 61 per cent less in quantity and 66 per cent less in value than in 1926.

The value of the metals produced from 318 lode mines in 1927 was $10,982,197, a decline of $3,828,119, or 26 per cent, as compared with the output of 335 lode mines in 1926. Gold produced at lode mines in 1927 ($5,833,705) was 13 per cent less, and silver (1,599,339 ounces, valued at $906,825) was 20 per cent less in quantity and 27 per cent less in value than in 1926. The quantity of ore, tailings, etc., handled at lode mines in 1927 was 1,526,410 short tons, or 13 per cent less than in 1926.

The total value of gold and silver produced by 465 placer mines in California in 1927 was $5,849,165, an increase of 12 per cent as compared with the output of 483 placers in 1926. The placer gold production was $5,837,313, an increase of 12 per cent; the quantity of silver recovered at placer mines was 20,903 ounces, an increase of 8 per cent over 1926, but its value ($11,852) was 2 per cent less.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only, for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

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[1] Helen M. Gaylord, of the Bureau of Mines, prepared the statistics for this report and wrote the review by counties.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

Mine production of gold, silver, copper, lead, and zinc in California, 1918–1927

Year	Mines producing		Ore, tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1918	388	315	2,503,411	799,588.10	$16,528,953	1,427,711	$1,427,711
1919	370	280	1,714,911	807,666.82	16,695,955	1,107,189	1,240,051
1920	301	199	1,165,022	692,296.70	14,311,043	1,706,327	1,859,896
1921	294	279	1,215,600	759,720.76	15,704,822	3,629,223	3,629,223
1922	283	282	1,539,933	709,677.99	14,670,346	3,100,065	3,100,065
1923	268	353	1,535,691	647,209.75	13,379,013	3,559,443	2,918,743
1924	267	266	2,019,200	636,139.72	13,150,175	3,555,133	2,381,939
1925	332	359	1,938,679	632,035.31	13,065,330	3,054,416	2,119,765
1926	335	483	1,760,859	576,798.40	11,923,481	2,022,460	1,262,015
1927	318	465	1,526,410	564,585.50	11,671,018	1,620,242	918,677

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	47,674,660	$11,775,641	13,372,049	$949,415	5,561,393	$506,087	$31,187,807
1919	21,732,507	4,042,246	3,568,267	189,118	472,990	34,528	22,201,898
1920	12,626,272	2,323,234	4,813,510	385,081	1,165,509	94,406	18,973,660
1921	11,743,404	1,514,899	1,124,276	50,592	846,184	42,309	20,941,845
1922	22,539,485	3,042,830	6,312,536	347,189	3,012,950	171,738	21,332,168
1923	28,317,759	4,162,711	9,549,680	668,478	----------	----------	21,128,945
1924	52,107,171	6,826,039	4,763,806	381,104	3,060,000	198,900	22,938,157
1925	46,864,913	6,654,818	6,566,200	571,259	11,489,237	873,182	23,284,354
1926	33,466,299	4,685,282	8,093,513	647,481	20,433,887	1,532,542	20,050,801
1927	27,133,008	3,554,424	2,718,014	171,235	8,062,625	516,008	16,831,362

Gold and silver produced at placer mines in California, 1918–1927

Year	Dredge				Drift			
	Gold		Silver		Gold		Silver	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
1918	359,519.46	$7,431,927	27,840	$27,840	5,244.82	$108,420	575	$575
1919	373,305.95	7,716,919	25,740	28,829	4,128.37	85,341	554	620
1920	333,805.20	6,900,366	28,918	31,521	3,044.00	62,925	374	408
1921	375,234.56	7,756,787	36,322	36,322	6,163.51	127,411	615	615
1922	241,837.04	4,999,215	16,608	16,608	12,220.79	252,626	1,391	1,391
1923	293,429.92	6,065,735	17,569	14,407	8,938.31	184,771	955	783
1924	208,279.59	4,305,521	14,793	9,911	4,768.22	98,568	560	375
1925	229,821.98	4,750,842	16,478	11,436	3,218.07	66,523	358	248
1926	239,482.59	4,950,545	17,287	10,787	5,381.06	111,236	942	588
1927	264,220.81	5,461,929	18,530	10,507	6,865.82	141,929	835	473

Gold and silver produced at placer mines in California, 1918–1927—Continued

Year	Hydraulic				Surface				Total value
	Gold		Silver		Gold		Silver		
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	
1918	10, 314. 95	$213, 229	903	$903	4, 121. 70	$85, 203	591	$591	$7, 868, 688
1919	8, 941. 25	184, 832	1, 249	1, 399	2, 224. 48	45, 984	381	427	8, 064, 351
1920	3, 204. 02	66, 233	413	450	1, 503. 93	31, 089	195	212	7, 093, 204
1921	7, 875. 84	162, 808	864	864	5, 215. 70	107, 818	829	829	8, 193, 454
1922	7, 656. 57	158, 275	906	906	4, 341. 10	89, 739	708	708	5, 519, 468
1923	5, 409. 68	111, 828	626	513	7, 752. 06	160, 249	1, 155	947	6, 539, 233
1924	2, 911. 93	60, 195	409	274	6, 002. 77	124, 088	928	622	4, 599, 554
1925	8, 482. 30	175, 345	958	665	5, 003. 61	103, 434	785	545	5, 109, 038
1926	3, 344. 62	69, 139	450	281	4, 715. 72	97, 483	683	426	5, 240, 485
1927	5, 845. 25	120, 832	700	397	5, 448. 14	112, 623	838	475	5, 849, 165

GOLD

The value of the mine production of gold in California in 1927 decreased $252,463, or 2 per cent, as compared with 1926. Lode mines yielded slightly less than 50 per cent and placer mines slightly more than 50 per cent of the total gold in 1927, as compared with 56 per cent and 44 per cent in 1926, 61 per cent and 39 per cent in 1925, and 65 per cent and 35 per cent, respectively, in 1924.

Four counties produced more than $1,000,000 each in gold in both 1927 and 1926. Yuba, with $3,468,201 in 1927 produced largely by dredges, was first in rank; Nevada, with $2,127,195 largely from gold lode mines, was second; Amador, with $1,922,714 almost entirely from gold lode mines, was third; and Sacramento, with $1,211,278 entirely from dredging, was fourth. The fifth largest output of gold, $678,873, came from Sierra County, largely from gold lode mines, and was followed by Trinity County with $409,492 largely from dredge and hydraulic placer mines. Calaveras County, which was fifth in rank in 1926, dropped to eighth place in 1927, being exceeded by Sierra, Trinity, and Plumas Counties in value of gold output.

The yield of gold from 465 placer mines in 1927 was valued at $5,837,313, an increase of 12 per cent as compared with the placer output from 483 mines in 1926. There was an increase of 10 per cent in gold yield by dredges, 28 per cent by drift mines, 75 per cent by hydraulic mines, and 16 per cent by surface mines, as compared with 1926. In 1927 dredges yielded 94 per cent, drift mines more than 2 per cent, hydraulic mines 2 per cent, and surface workings nearly 2 per cent of the gold from California placer deposits. Production of gold by the 25 dredges operating in 1927 was $5,461,929, as compared with $4,950,545 by 23 dredges in 1926 and $4,750,842 by 24 dredges in 1925.

The output of gold from 318 lode mines in California in 1927 was valued at $5,833,705, a decrease of 13 per cent as compared with 1926, following decreases of 16 per cent in 1926 from 1925 and 7 per cent in 1925 from 1924.

Gold ore and tailings treated in 1927 yielded nearly 93 per cent, copper ore and tailings nearly 6 per cent, and silver ore and tailings 1 per cent of the total gold from lode mines. Amalgamation mills in 1927 recovered approximately 75 per cent, cyanidation plants 15 per cent, and smelters 10 per cent of the lode gold output of California, as compared with 75 per cent, 17 per cent, and 8 per cent, respectively, in 1926.

It is estimated that approximately 4 per cent of the gold output from lode mines was stolen and sold by "high graders" in 1927, compared with 6 per cent in each of the two preceding years.

In 1927 there were 33 companies in the State that produced more than 1,000 ounces of gold each, and they contributed 91 per cent of the total gold output of the State; in 1926 there were 34 companies that produced more than 1,000 ounces each. Of the 33 larger companies 7 produced more than 20,000 ounces each and 2 more than 50,000 ounces; 11 of them operated 22 gold dredges, 2 operated drift placer mines, 1 operated a silver mine, 3 operated copper mines, and 16 operated gold lode mines. The 10 largest gold-producing companies in California in 1927, in order of output, were the Yuba Consolidated Gold Fields (6 dredges), Natomas Co. of California (6 dredges), Empire Mines Co. (gold lode), Kennedy Mining & Milling Co. (gold lode), North Star Mines Co. (gold lode), Original Sixteen to One Mines Co. (Inc.) (gold lode), Argonaut Mining Co. (gold lode), Central Eureka Mining Co. (gold lode), Walker Mining Co. (copper mine), and the Original Mining & Milling Co. (gold lode).

SILVER

The mine production of silver in California in 1927 was 1,620,242 ounces, valued at $918,677, a decrease of 20 per cent in quantity and 27 per cent in value as compared with 1926. Three counties yielded more than 100,000 ounces of silver each in 1927, namely, San Bernardino County, with 788,580 ounces largely from silver ore produced by the California Rand Silver (Inc.); Plumas County, with 315,887 ounces largely from copper ores of the Engels and Walker mines; and Shasta County, with 123,917 ounces largely from zinc and copper ores. Inyo and Mono Counties were in the 100,000-ounce class in 1926, but each produced less than 100,000 ounces in 1927. The fourth largest producer of silver in 1927 was Napa County, with 99,532 ounces, all from silver ores, followed by Inyo County, with 83,570 ounces mostly from lead ores.

The yield of silver from placer mines in 1927 was 20,903 ounces, 8 per cent more than in 1926 and about 1 per cent of the total silver output of the State. Of the 1,599,339 ounces of silver produced at lode mines in 1927 silver ore and tailings yielded 58 per cent (virtually the same as in 1926), copper ore and tailings 25 per cent (20 per cent in 1926), gold ore and tailings 6 per cent (5 per cent in 1926), lead ore and tailings nearly 5 per cent (6 per cent in 1926), zinc ore 4 per cent (7 per cent in 1926), lead-zinc ore 2 per cent (4 per cent in 1926), and lead-copper ore less than one-fourth of 1 per cent.

Each of 43 properties in 1927 produced more than 1,000 ounces of silver, as compared with 46 properties in 1926; these mines yielded 98 per cent of the total silver produced in the State in both 1927 and 1926. At 27 properties (31 in 1926) the yield was between 1,000 and 10,000 ounces, at 13 (10 in 1926) between 10,000 and 100,000, at 2 (4 in 1926) between 100,000 and 300,000, and at 1 mine in excess of 700,000 ounces in 1927. No mine in California produced as much as 1,000,000 ounces of silver in 1927 or 1926. The 10 largest producers of silver in California in 1927, in order of output, were the California Rand Silver (Inc.), Walker Mining Co., Engels Copper Mining Co., Palisades Mines Co., California Zinc Co., Mason Mining Co. (Balaklala), Mono Mining Co. of Nevada, American Metals (Inc.) (Darwin), North Star Mines Co., and the Santa Catalina Island Co.

COPPER

The mine production of copper in California in 1927 was 27,133,008 pounds, valued at $3,554,424, a decrease of 19 per cent in quantity and 24 per cent in value as compared with 1926. Plumas County again led in copper output, yielding 21,055,404 pounds, a decrease of 1,107,631 pounds, or 5 per cent, as compared with 1926. Shasta County was second in rank, producing 4,524,906 pounds, a decrease of 536,449 pounds, or 11 per cent, as compared with 1926. Trinity County was third in rank, with a yield of 733,756 pounds. Calaveras County ranked fourth, with a yield of only 577,969 pounds, as compared with 5,240,733 pounds in 1926, a decrease of 4,662,764 pounds, or 89 per cent. Copper was also produced in San Bernardino, Inyo, and Riverside Counties, and in much smaller quantities in Mono, Imperial, and Butte Counties.

Copper ore was the source of 91 per cent, mine water and tailings of 6 per cent, and zinc ore of nearly 3 per cent of the copper recovered in 1927. A minor quantity of copper was recovered from siliceous silver ore, lead ore, and lead-copper ore.

Crude ore smelted in California in 1927 yielded 12 per cent; concentrates smelted, 82 per cent; and tailings, including pyrite cinder and cement copper from mine water smelted, 6 per cent of the copper output of the State.

In 1927 California produced 785,366 tons of copper ore, which had an average assay content of 0.021 ounce of gold and 0.488 ounce of silver a ton and 1.612 per cent of copper.

LEAD

The total mine yield of lead in California in 1927 was 2,718,014 pounds, valued at $171,235, a decrease of 66 per cent in quantity and 74 per cent in value as compared with 1926. Lead ore and tailings supplied 84 per cent, lead-zinc ore 11 per cent, and lead-copper ore 4 per cent of the lead output of the State. Crude ore smelted yielded 48 per cent, concentrates smelted 42 per cent, and old slags and tailings smelted 10 per cent of the lead produced in 1927.

Only 17 properties in Inyo County shipped lead ore in 1927, as compared with 25 in 1926. The county yielded 2,162,623 pounds of lead, or 80 per cent of the output of the State. The next largest output of lead (296,692 pounds) came from concentrates milled from lead-zinc ore mined at the Black Jack and Renton mines on Catalina Island, Los Angeles County. San Bernardino County ranked third with 125,560 pounds which came from mines in the Clark and Shadow Mountains. Riverside County ranked fourth in 1927 with a yield of 121,867 pounds.

The 12,302 tons of lead ore produced by 31 mines in California in 1927 had an average assay content of 0.026 ounce of gold, and 4.399 ounces of silver a ton, 0.072 per cent of copper, and 8.495 per cent of lead.

ZINC

The mine production of zinc in California in 1927 was 8,062,625 pounds, valued at $516,008, a decrease of 61 per cent in quantity and 66 per cent in value as compared with 1926, following increases of 78 per cent in quantity and 76 per cent in value in 1926 over 1925. Shasta County produced 83 per cent of the total zinc (87 per cent in 1926), and Los Angeles County 17 per cent. The California Zinc Co. in Shasta County and the Santa Catalina Island Co. in Los Angeles County concentrated their ore by flotation and exported the zinc concentrate. Zinc ore yielded 83 per cent and mixed lead-zinc ore 17 per cent of the total zinc produced in the State. Flotation concentrates smelted yielded the entire zinc output of the State in 1927.

Mine production of gold, silver, copper, lead, and zinc in California in 1927, by counties

County	Mines producing		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	1	-------	7.07	$146	------------	------------	7.07	$146
Amador	15	8	92,702.49	1,916,331	308.78	$6,383	93,011.27	1,922,714
Butte	2	32	9.68	200	6,931.85	143,294	6,941.53	143,494
Calaveras	36	19	4,373.57	90,410	6,231.06	128,807	10,604.63	219,217
Del Norte	-------	1	------------	------------	18.58	384	18.58	384
Eldorado	12	36	2,960.84	61,206	1,018.21	21,048	3,979.05	82,254
Fresno	2	4	38.94	805	803.07	16,601	842.01	17,406
Humboldt	-------	6	------------	------------	83.65	1,729	83.65	1,729
Imperial	1	-------	12.44	257	------------	------------	12.44	257
Inyo	25	1	471.62	9,749	17.42	360	489.04	10,109
Kern	26	4	8,254.98	170,646	21.98	454	8,276.96	171,100
Lassen	1	-------	25.69	531	------------	------------	25.69	531
Los Angeles	1	2	------------	------------	113.42	2,345	113.42	2,345
Madera	4	3	189.73	3,922	12.52	259	202.25	4,181
Mariposa	17	16	8,669.53	179,215	222.05	4,590	8,891.58	183,805
Mono	9	-------	178.31	3,686	------------	------------	178.31	3,686
Monterey	1	-------	24.18	500	------------	------------	24.18	500
Napa	1	-------	350.00	7,235	------------	------------	350.00	7,235
Nevada	17	24	100,585.60	2,079,289	2,317.47	47,906	102,903.07	2,127,195
Placer	6	40	2,672.28	55,241	2,043.99	42,253	4,716.27	97,494
Plumas	9	40	14,652.84	302,901	876.30	18,115	15,529.14	321,016
Riverside	2	-------	72.18	1,492	------------	------------	72.18	1,492
Sacramento	-------	7	------------	------------	58,595.57	1,211,278	58,595.57	1,211,278
San Bernardino	38	4	3,942.04	81,489	35.59	736	3,977.63	82,225
San Diego	4	-------	555.83	11,490	------------	------------	555.83	11,490
Shasta	11	27	1,929.10	39,878	7,354.07	152,022	9,283.17	191,900
Sierra	12	21	31,505.63	651,279	1,334.84	27,594	32,840.47	678,873
Siskiyou	14	77	4,497.03	92,962	2,218.50	45,860	6,715.53	138,822
Stanislaus	-------	3	------------	------------	5,816.49	120,238	5,816.49	120,238
Trinity	8	53	1,473.90	30,468	18,335.29	379,024	19,809.19	409,492
Tuolumne	41	14	1,872.35	38,705	72.75	1,504	1,945.10	40,209
Yuba	2	23	177.63	3,672	167,596.57	3,464,529	167,774.20	3,468,201
	318	465	282,205.48	5,833,705	282,380.02	5,837,313	564,585.50	11,671,018
Total, 1926	335	483	323,874.41	6,695,078	252,923.99	5,228,403	576,798.40	11,923,481

Mine production of gold, silver, copper, lead, and zinc in California in 1927, by counties—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	105	$60			105	$60
Amador	19,920	11,295	43	$24	19,963	11,319
Butte	87	49	568	322	655	371
Calaveras	6,462	3,664	561	318	7,023	3,982
Del Norte			2	1	2	1
Eldorado	577	327	98	56	675	383
Fresno	5	3	131	74	136	77
Humboldt			25	14	25	14
Imperial	5	3			5	3
Inyo	83,568	47,383	2	1	83,570	47,384
Kern	15,745	8,927	8	5	15,753	8,932
Lassen	16	9			16	9
Los Angeles	26,116	14,808	19	11	26,135	14,819
Madera	58	33	9	5	67	38
Mariposa	2,384	1,352	43	24	2,427	1,376
Mono	38,487	21,822			38,487	21,822
Monterey	4	2			4	2
Napa	99,532	56,435			99,532	56,435
Nevada	48,256	27,361	388	220	48,644	27,581
Placer	496	281	280	159	776	440
Plumas	315,804	179,061	83	47	315,887	179,108
Riverside	3,385	1,919			3,385	1,919
Sacramento			2,596	1,472	2,596	1,472
San Bernardino	788,576	447,123	4	2	788,580	447,125
San Diego	162	92			162	92
Shasta	123,020	69,752	897	509	123,917	70,261
Sierra	5,792	3,284	117	66	5,909	3,350
Siskiyou	674	382	359	204	1,033	586
Stanislaus			608	345	608	345
Trinity	19,554	11,087	2,185	1,239	21,739	12,326
Tuolumne	522	296	11	6	533	302
Yuba	27	15	11,866	6,728	11,893	6,743
	1,599,339	906,825	20,903	11,852	1,620,242	918,677
Total, 1926	2,003,098	1,249,933	19,362	12,082	2,022,460	1,262,015

County	Copper		Lead		Zinc		Grand total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine							$206
Amador							1,934,033
Butte	40	$5	130	$8			143,878
Calaveras	577,969	75,714	4,460	281			299,194
Del Norte							385
Eldorado							82,637
Fresno							17,483
Humboldt							1,743
Imperial	47	6					266
Inyo	30,035	3,935	2,162,623	136,245			197,673
Kern							180,032
Lassen							540
Los Angeles			296,692	18,692	1,351,375	$86,488	122,344
Madera							4,219
Mariposa							185,181
Mono	95	12	4,902	309			25,829
Monterey							502
Napa							63,670
Nevada							2,154,776
Placer							97,934
Plumas	21,055,404	2,758,258					3,258,382
Riverside	17,119	2,243	121,867	7,678			13,332
Sacramento							1,212,750
San Bernardino	193,637	25,366	125,560	7,910			562,626
San Diego							11,582
Shasta	4,524,906	592,763	1,780	112	6,711,250	429,520	1,284,556
Sierra							682,223
Siskiyou							139,408
Stanislaus							120,583
Trinity	733,756	96,122					517,940
Tuolumne							40,511
Yuba							3,474,944
	27,133,008	3,554,424	2,718,014	171,235	8,062,625	516,008	16,831,362
Total, 1926	33,466,299	4,685,282	8,093,513	647,481	20,433,887	1,532,542	20,050,801

Gold and silver produced at placer mines in California, 1926 and 1927, by counties

County	Dredge		Drift		Hydraulic		Surface		Total value
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	
1926		*Fine ounces*		*Fine ounces*		*Fine ounces*		*Fine ounces*	
Amador			$324	1	$4, 649	23	$1, 455	12	$6, 450
Butte	$209, 441	948	2, 494	10	92		16, 004	73	228, 674
Calaveras	46, 855	164	15, 674	95	653	4	3, 499	24	66, 860
Del Norte					151		927	6	1, 082
Eldorado			5, 164	12			8, 145	60	13, 354
Fresno			80				7, 526	60	7, 643
Humboldt					928	8	315	2	1, 249
Kern							219	6	223
Lassen							67	1	68
Madera							183	1	184
Mariposa							2, 461	28	2, 478
Nevada			12, 112	58			1, 184	14	13, 341
Placer	23, 843	134	25, 610	148			8, 613	56	58, 277
Plumas			34, 462	514	3, 160	16	901	11	38, 861
Sacramento	1, 303, 465	2, 595	41	1			540	11	1, 305, 673
San Bernardino							1, 243	12	1, 250
San Diego							95		95
Santa Cruz							143	1	144
Shasta	69, 480	612					7, 619	61	77, 519
Sierra			4, 309	26	8, 802	24	4, 367	29	17, 527
Siskiyou					21, 629	178	12, 528	98	34, 329
Stanislaus	117, 043	616					10, 355	43	127, 809
Trinity	418, 702	2, 039	1, 344	9	29, 075	197	1, 081	6	451, 607
Tuolumne			2, 065	13			7, 616	67	9, 731
Yuba	2, 761, 716	10, 179	7, 557	55			397	1	2, 776, 057
	4, 950, 545	17, 287	111, 236	942	69, 139	450	97, 483	683	5, 240, 485
1927									
Amador			191	2	5, 130	30	1, 062	11	6, 407
Butte	128, 621	471	9, 555	66			5, 118	31	143, 616
Calaveras	74, 356	275	51, 033	266	121	2	3, 297	18	129, 125
Del Norte					384	2			385
Eldorado			12, 707	33	306	2	8, 035	63	21, 104
Fresno							16, 601	131	16, 675
Humboldt					1, 339	21	390	4	1, 743
Inyo							360	2	361
Kern							454	8	459
Los Angeles							2, 345	19	2, 356
Madera							259	9	264
Mariposa							4, 590	43	4, 614
Nevada			36, 363	307	6, 383	44	5, 160	37	48, 126
Placer	8, 277	49	13, 490	73			20, 486	158	42, 412
Plumas			10, 633	46	4, 449	23	3, 033	14	18, 162
Sacramento	1, 211, 278	2, 596							1, 212, 750
San Bernardino							736	4	738
Shasta	137, 092	790					14, 930	107	152, 531
Sierra			3, 780	22	19, 205	69	4, 609	26	27, 660
Siskiyou					33, 945	257	11, 915	102	46, 064
Stanislaus	115, 471	587					4, 767	21	120, 583
Trinity	326, 701	1, 917	2, 173	12	49, 570	250	580	6	380, 263
Tuolumne							1, 504	11	1, 510
Yuba	3, 460, 133	11, 845	2, 004	8			2, 392	13	3, 471, 257
	5, 461, 929	18, 530	141, 929	835	120, 832	700	112, 623	838	5, 849, 165

MINING INDUSTRY

The output of gold, silver, copper, lead, and zinc in California in 1927 was from 32 counties, as compared with 34 counties in 1926. Production in 1927 came from 783 properties (818 in 1926), of which 465 were placers and 318 were lode mines. In 1927 no output was recorded from Modoc, Orange, and Santa Cruz Counties, which made a small output in 1926. Mines in Alpine County produced in 1927 but not in 1926. Named in order of output, the 9 counties making the largest production of metals in 1927 were Yuba, Plumas, Nevada, Amador, Shasta, and Sacramento, each with a yield of more than a million dollars, and Sierra, San Bernardino, and Trinity, each with more than half a million. The yield of Amador, Nevada, and

Sierra Counties was largely from gold lode mines, that of Plumas largely from copper mines, that of Shasta largely from copper and zinc mines, that of San Bernardino largely from a silver mine, that of Yuba and Trinity Counties largely from gold dredges, and that of Sacramento County entirely from gold dredges.

The lode mines yielding gold were less productive than in 1926, but much development was going on at various camps. Placer miners increased their output over 1926 by 12 per cent; every class of mining showed an increase. The hydraulic season was long, because of an abundance of snow in the winter of 1926–27.

In the northern counties the California Zinc Co., at the Bully Hill and Afterthought zinc mines, operated only part of the year. The Mason Mining Co., at the Balaklala mine, and the Island Copper Co., at the Island Mountain mine, were operating normally. A large number of hydraulic mines were working.

The Yuba Consolidated Gold Fields, the largest producer of gold in California, operated six dredges on the Feather River at Hammonton, Yuba County. The Engels and Walker copper mines in Plumas County were the largest producers of copper in the State in 1927. In Sierra County the Original Sixteen to One mine made a large yield of gold, and there was more activity in all camps than for some years. In the Grass Valley-Nevada City district there was considerable activity. The Empire continued operations on its usual scale, the extensive deep development program at the North Star opened up some good ore, the Idaho-Maryland had a successful year, and several new operations began production.

On the Mother Lode the Plymouth mine, at Plymouth, Amador County, was worked throughout the year by the Argonaut interests; the Central Eureka at Sutter Creek had a successful year; the Kennedy, at Jackson, continued its large production; and the Argonaut was worked on a greater scale than in 1926. The Carson Hill mines near Melones, Calaveras County, were closed throughout the year, pending refinancing, and the other mines in the county were very quiet. In Tuolumne County there was some activity at several smaller mines near Jamestown and Tuttletown, but the larger properties were not operated. There was very little activity at the mines on the Lode in Mariposa County.

Ore treated and gold and silver recovered at gold mills in Mother Lode counties in California in 1927 [1]

County	Ore treated	Gold and silver recovered in bullion			Concentrates produced [2]	Gold and silver recovered from concentrates			Value of total recovery	
		Gold	Silver	Average value per ton of ore		Gold	Silver	Average value per ton of concentrates	Total	Average value per ton of ore
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*			
Amador	265,626	75,221.40	15,214	$5.89	4,526	17,330.42	4,649	$79.74	$1,924,540	$7.25
Calaveras	16,053	3,919.97	826	5.08	36	160.53	75	93.36	84,862	5.29
Eldorado	3,801	2,753.99	520	15.06	39	193.29	51	103.21	61,250	16.11
Mariposa	12,361	8,427.34	2,093	14.19	57	223.64	286	83.95	180,181	14.58
Tuolumne	4,166	1,732.01	397	8.65	24	32.39	83	29.88	36,746	8.82
	302,007	92,057.71	19,050	6.34	4,682	17,940.27	5,144	79.83	2,287,579	7.57

[1] Tailings excluded.

[2] Includes only concentrates made from gold

Bouery [2] has given an interesting narrative of mining conditions on the Mother Lode between Jackson, Amador County, and La Grange, Stanislaus County. Conditions in 1927 were much as he saw them in the fall of 1926. Considerable small work was going on, but with a few notable exceptions very little mining on the scale that should be expected on the Lode.

The average recovery of gold and silver from Mother Lode ores treated in 1927 was $7.57 a ton, $6.34 of which was recovered as bullion and the remainder in concentrates having an average value of $79.83 a ton. Comparable figures for 1926 are $7.43 a ton for total recovery, $6.15 of which was recovered as bullion and the remainder in concentrates having an average value of $83.07 a ton. The recovery in Mother Lode milling practice probably ranges from 85 to 98 per cent.

The Zenda mine near Loraine, Kern County, produced for a few months of 1927. At Randsburg the California Rand Silver (Inc.) produced throughout the year, and several gold lode mines in the district were operated.

The older and larger properties, such as have been contributing to the lead yield of Inyo County for some years, all produced less than in 1926. The Tecopa, a continuous producer for many years, was shut down in October and the Ophir in July.

In the southern counties the largest yield was from the lead-zinc mines on Catalina Island. Copper ore was shipped from the Run Over Consolidated group near Goffs, San Bernardino County, and the Mecca Mines (Inc.), in Riverside County, shipped to Arizona smelters. Several gold properties in the vicinity of Victorville and Perris were under development.

The dredging industry of California was 10 per cent more productive than in 1926, the yield of gold and silver from dredges in 1927 being valued at $5,472,436, of which $5,461,929 was in gold. There were 25 boats in operation in 1927, as compared with 23 in 1926. Two dredges on Cottonwood Creek and one boat on Clear Creek, Shasta County, were digging in 1927, and three boats on Trinity River, Trinity County, were worked. In Butte County the Holton dredge, operating on the Feather River, was burned in June; the Shasta-Butte dredge began work in August. One dredge on Willow Creek and the six boats of the Yuba Consolidated Gold Fields were operated in Yuba County. The Colfax Dredging Co. ceased operations in May and dismantled its boat, which had been working on the North Fork of the American River. Six boats of the Natomas Co. of California were in operation in the Natoma field, Sacramento County, and one of two new boats for the Capital Dredging Co. was placed in commission. In Calaveras County one dredge was operated on the Calaveras River near Jenny Lind. In Stanislaus County one boat was operated on the Tuolumne River, and a second dredge was building. The total quantity of gravel dug by all dredges in 1927 was 51,327,469 cubic yards (52,084,500 in 1926), indicating an average recovery in gold and silver of 10.66 cents a yard as compared with 9.53 cents in 1926. The total production of gold by dredges since the beginning of the industry has been $155,533,771, of which the

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[2] Bouery, P., Mining on the Mother Lode in California: Eng. and Min. Jour., vol. 122, No. 12, 1926, pp. 456–459.

Feather River field has yielded $33,211,970, the Yuba River field $60,529,485, and the American River field $36,134,081.

Gibson[3] has given a brief review of placer mining in the past and indicates that new dredge fields will probably be opened as a result of some work he has done.

The mineral resources section of the Commonwealth Club of California during the winter of 1927–28 devoted its energies to a study of hydraulic mining and the possibility of its revival. Many able papers were presented by the mining fraternity. Several criticisms by representatives of the agricultural interests of the valley counties are on record.[4]

Elliott,[5] after reviewing the history of hydraulic mining in the State and the present knowledge and advances in hydraulic mining methods and dam construction, proposed that débris dams on the principal streams, where hydraulic mining would be possible, be built by the Federal Government as postulated in the Caminetti Act and that the cost of such dams be returned by the miners through a production tax.

Representative Englebright,[6] of Nevada City, Calif., contributed to the discussion of this question and pointed out the benefits that would accrue not only to the mining industry and the agricultural interests but to the nation by adding to the gold supply a part of the $600,000,000 that is believed to be locked up in the buried channels of the Sierra Nevada.

The present attitude of the mining fraternity of California is well summarized in an editorial in the September 3, 1927, issue of the Engineering and Mining Journal, which states:

> The Commonwealth Club of California, through its mineral resources committee, will investigate the hydraulic mining situation in California and try to ascertain the pertinent facts about the resumption of such mining in the State. The club is a disinterested organization which investigates from time to time major questions having to do with industrial progress, economics, and politics affecting the people of California. A program has been initiated through which the miners, agriculturists, and power interests will be enabled to present the views of the industries which they respectively represent and such facts as are pertinent.
>
> An unprejudiced review of the hydraulic mining situation is greatly to be desired, for at the last session of the Legislature in California, when the small remnant of hydraulic miners made their appeal for recognition and the initiation of a definite plan for resumption of hydraulic mining, they were met by determined and prejudiced opposition from agricultural interests. The latter reflected the bitterness which has existed for many years. That conditions have changed materially and that modern methods have in themselves sufficient merit not only to permit of hydraulic mining under adequate restrictions but also to improve irrigation possibilities, were facts that were refused recognition. The farmers would not consider anything except the absolute prevention of hydraulic mining.
>
> The attitude of the hydraulic miners has been patient. They have advanced their ideas and have discussed their plans in detail, meeting, with facts and figures, the specific objections that have appeared between the chinks of lawyers' oratory and bombast. The Commonwealth Club will do a public service of great value if it will ascertain the facts and lay them before the public for inspection.

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[3] Gibson, Arthur, Auriferous Placer Resources of California: Min. Cong. Jour., vol. 13, No. 6, 1927, pp. 476–479.

[4] Transactions of the Commonwealth Club of California, Hydraulic Miners Versus Valley Farmers: Vol. 23, No. 5, part 2, May 29, 1928.

[5] Elliott, Roy H., A Proposed Plan for the Rehabilitation of Hydraulic Mining: Min. Cong. Jour., vol. 13, No. 11, 1927, pp. 817–820, 850.

[6] Englebright, H. L., The Case for the Hydraulic Mining Industry: Min. Cong. Jour., vol. 13, No. 10, 1927, pp. 756–758, 766.

Ore, tailings, etc., sold or treated in California, 1921–1927, with content in terms of recovered metals

Year	Ore, tailings, etc	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
DRY GOLD ORE						
1921	863, 720	353, 993. 36	108, 603	9, 878	640	
1922	984, 785	430, 809. 45	97, 128	3, 296	1, 981	
1923	789, 026	311, 477. 79	82, 787	192	288	
1924	986, 098	383, 796. 60	155, 869	700	5, 613	
1925	803, 712	359, 390. 88	104, 560	122		
1926	660, 095	306, 451. 20	98, 427	119, 846	3, 991	
1927	576, 976	261, 778. 49	97, 444	706	5, 552	
DRY SILVER ORE						
1921	38, 846	8, 940. 86	3, 220, 927			
1922	67, 363	5, 092. 94	2, 375, 361	7, 514	215	
1923	136, 633	9, 979. 00	2, 762, 977	4, 950	4, 130	
1924	89, 760	8, 255. 74	2, 295, 683			
1925	82, 913	7, 073. 75	1, 992, 859			
1926	57, 231	4, 069. 57	1, 154, 087	714	679	
1927	42, 146	3, 134. 97	935, 145	18, 301	1, 261	
COPPER ORE						
1921	306, 134	1, 439. 01	175, 870	11, 599, 540		
1922	447, 200	5, 728. 85	320, 977	21, 845, 111	214	
1923	571, 645	8, 523. 74	360, 345	28, 238, 052		
1924	917, 806	21, 129. 50	876, 293	51, 668, 117		
1925	999, 006	16, 584. 58	704, 506	[1] 46, 166, 627		
1926	930, 464	11, 233. 14	397, 174	[1] 31, 413, 715	687	
1927	854, 084	16, 556. 80	393, 533	[1] 26, 288, 052		
LEAD ORE						
1921	3, 947	806. 93	82, 267	34, 853	1, 123, 636	
1922	26, 466	1, 451. 81	263, 681	65, 944	6, 305, 832	
1923	38, 304	1, 654. 38	330, 241	66, 881	9, 510, 172	
1924	16, 536	795. 37	188, 098	78, 354	4, 758, 193	
1925	18, 208	2, 277. 62	174, 494	58, 342	6, 364, 985	27, 238
1926	30, 445	1, 027. 29	128, 027	34, 669	6, 740, 354	
1927	14, 066	330. 46	72, 644	13, 841	2, 290, 862	
ZINC ORE						
1921	2, 953	50. 99	2, 926	99, 133		846, 184
1922	14, 072	529. 48	15, 390	613, 482		3, 012, 950
1923						
1924	9, 000	200. 00	22, 500	360, 000		3, 060, 000
1925	33, 384	180. 02	33, 492	639, 822	4, 072	11, 125, 523
1926	57, 079	950. 99	150, 053	1, 875, 230	6, 695	17, 866, 237
1927	24, 266	335. 68	71, 074	798, 722	1, 780	6, 711, 250
LEAD-COPPER ORE						
1921						
1922	47	9. 95	7, 915	4, 138	4, 294	
1923	83	44. 87	2, 788	7, 684	35, 090	
1924–25						
1926	383	135. 60	5, 022	22, 125	173, 207	
1927	193	69. 08	3, 383	13, 386	121, 867	
LEAD-ZINC ORE [2]						
1925	1, 456	2. 50	25, 926		197, 143	336, 476
1926	25, 162	6. 62	70, 308		1, 167, 900	2, 567, 650
1927	14, 679		26, 116		296, 692	1, 351, 375

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[1] Includes copper from mine water.

[2] No lead-zinc ore, classified as such, in 1921 to 1924, inclusive.

Ore, tailings, etc., sold or treated in California in 1927, with content in terms of recovered metals

Source	Mines producing	Ore, tailings, etc.		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore and tailings	253	576, 976	37. 80	261, 778. 49	46. 37	97, 444	6. 01
Dry silver ore and tailings	17	42, 146	2. 76	3, 134. 97	. 56	935, 145	57. 72
Copper ore, tailings, etc	13	854, 084	55. 96	16, 556. 80	2. 93	393, 533	24. 29
Lead ore and tailings	32	14, 066	. 92	330. 46	. 06	72, 644	4. 48
Zinc ore	1	24, 266	1. 59	335. 68	. 06	71, 074	4. 39
Lead-copper ore	1	193	. 01	69. 08	---	3, 383	. 21
Lead-zinc ore	1	14, 679	. 96	---	---	26, 116	1. 61
Total, lode mines	[1] 318	1, 526, 410	100. 00	282, 205. 48	49. 98	1, 599, 339	98. 71
Total, placers	465	---	---	282, 380. 02	50. 02	20, 903	1. 29
	783	1, 526, 410	100. 00	564, 585. 50	100. 00	1, 620, 242	100. 00
Total, 1926	818	1, 760, 859	---	576, 798. 40	---	2, 022, 460	---

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore and tailings	706	---	5, 552	0. 20	---	---
Dry silver ore and tailings	18, 301	0. 07	1, 261	. 05	---	---
Copper ore, tailings, etc	[2] 26, 288, 052	96. 89	---	---	---	---
Lead ore and tailings	13, 841	. 05	2, 290, 862	84. 28	---	---
Zinc ore	798, 722	2. 94	1, 780	. 07	6, 711, 250	83. 24
Lead-copper ore	13, 386	. 05	121, 867	4. 48	---	---
Lead-zinc ore	---	---	296, 692	10. 92	1, 351, 375	16. 76
	27, 133, 008	100. 00	2, 718, 014	100. 00	8, 062, 625	100. 00
Total, 1926	33, 466, 299	---	8, 093, 513	---	20, 433, 887	---

[1] A mine producing more than one class of ore is counted but once in arriving at total for all classes.
[2] Includes copper from mine water.

Ore, tailings, etc., sold or treated in California in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	[1] 2	7. 07	105	---	---	---
Amador	[2] 266, 486	92, 702. 49	19, 920	---	---	---
Butte	15	9. 07	5	---	---	---
Calaveras	16, 066	4, 215. 86	979	---	4, 460	---
Eldorado	[3] 3, 871	2, 960. 84	577	---	---	---
Fresno	86	38. 94	5	---	---	---
Imperial	50	12. 44	5	47	---	---
Inyo	[4] 1, 164	170. 02	93	125	---	---
Kern	[5] 23, 837	8, 253. 83	15, 381	---	---	---
Lassen	50	25. 69	16	---	---	---
Madera	274	189. 73	58	---	---	---
Mariposa	12, 362	8, 669. 53	2, 384	---	---	---
Mono	[6] 56	117. 38	415	---	1, 092	---
Monterey	20	24. 18	4	---	---	---
Nevada	192, 017	100, 585. 60	48, 256	---	---	---
Placer	2, 919	2, 672. 28	496	---	---	---
Plumas	[7] 3, 497	530. 01	154	---	---	---
San Bernardino	1, 935	1, 015. 41	712	534	---	---
San Diego	2, 085	555. 83	162	---	---	---
Shasta	288	500. 25	71	---	---	---
Sierra	[8] 32, 795	31, 505. 63	5, 792	---	---	---
Siskiyou	7, 691	4, 497. 03	674	---	---	---

[1] Tailings.
[2] Includes 660 tons of tailings.
[3] Includes 10 tons of tailings.
[4] Includes 1,010 tons of tailings.
[5] Includes 1,450 tons of tailings.
[6] Includes 1 ton of tailings.
[7] Includes 19 tons of tailings.
[8] Includes 10 tons of tailings.

Ore, tailings, etc., sold or treated in California in 1927, by counties, with content in terms of recovered metals—Continued

DRY GOLD ORE—Continued

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Trinity	4,598	469.40	631			
Tuolumne	4,170	1,872.35	522			
Yuba	642	177.63	27			
Total, 1926	576,976 660,095	261,778.49 306,451.20	97,444 98,427	706 119,846	5,552 3,991	

DRY SILVER ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Inyo	691	22.12	21,451	15,494		
Kern	3	1.15	364			
Mono	794	31.62	37,911	95		
Napa	3,351	350.00	99,532			
San Bernardino	[9] 37,307	2,730.08	775,887	2,712	1,261	
Total, 1926	42,146 57,231	3,134.97 4,069.57	935,145 1,154,087	18,301 714	1,261 679	

COPPER ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Calaveras	[10] 8,338	157.71	5,483	577,969		
Inyo	38	12.61	28	1,662		
Plumas	724,827	14,122.83	315,650	21,055,404		
Riverside	23	3.10	2	3,733		
San Bernardino	1,962	162.88	1,572	189,344		
Shasta	[11] 102,096	1,093.17	51,875	[12] 3,726,184		
Trinity	16,800	1,004.50	18,923	733,756		
Total, 1926	854,084 930,464	16,556.80 11,233.14	393,533 397,174	26,288,052 [12] 31,413,715	 687	

LEAD ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Butte	1	0.61	82	40	130	
Inyo	[13] 13,710	266.87	61,996	12,754	2,162,623	
Mono	18	29.31	161		3,810	
San Bernardino	337	33.67	10,405	1,047	124,299	
Total, 1926	14,066 30,445	330.46 1,027.29	72,644 128,027	13,841 34,669	2,290,862 6,740,354	

ZINC ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Shasta	24,266	335.68	71,074	798,722	1,780	6,711,250
Total, 1926	24,266 57,079	335.68 950.99	71,074 150,053	798,722 1,875,230	1,780 6,695	6,711,250 17,866,237

LEAD-COPPER ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Riverside	193	69.08	3,383	13,386	121,867	
Total, 1926	193 383	69.08 135.60	3,383 5,022	13,386 22,125	121,867 173,207	

LEAD-ZINC ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Los Angeles	14,679		26,116		296,692	1,351,375
Total, 1926	14,679 25,162	 6.62	26,116 70,308		296,692 1,167,900	1,351,375 2,567,650

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[9] Includes 500 tons of tailings.

[10] Includes 1,466 tons of tailings.

[11] Includes 67,252 tons of tailings.

[12] Includes copper from mine water.

[13] Includes 1,764 tons of tailings.

METALLURGIC INDUSTRY

The quantity of ore treated at gold and silver mills by amalgamation and cyanidation in 1927 was 578,629 tons, a decrease of 14 per cent as compared with 1926. Bullion saved at amalgamation mills carried 87 per cent of the gold and 24 per cent of the silver, and cyanide precipitates carried 13 per cent of the gold and 76 per cent of the silver recovered by treatment of ores at gold and silver mills in 1927.

Gold and silver mills, in addition to ores, treated 2,130 tons of tailings by amalgamation and 1,510 tons by cyanidation, which yielded 586.70 ounces of gold and 1,454 ounces of silver.

Cyanide plants treated 3,812 tons of concentrates in 1927 as compared with 5,273 tons in 1926, a decrease of 28 per cent.

Concentrates produced in 1927 at gold and silver mills in which the ore was first amalgamated amounted to 5,089 tons and yielded 19,604.82 ounces of gold, 23,038 ounces of silver, and 4,460 pounds of lead at cyanidation works or smelters.

Concentrating mills in 1927 treated 814,639 tons of ore, a decrease of 11 per cent as compared with 1926. Total concentrates, including those from gold and silver mills, amounted to 61,483 tons, a decrease of 35 per cent as compared with 1926. The quantity of each class of concentrates declined as compared with 1926—dry gold, 25 per cent; dry silver, 21 per cent; copper, 33 per cent; lead, 2 per cent; and zinc, 50 per cent.

The quantity of crude ore shipped to smelters in 1927 was 58,998 tons, or 7 per cent less than in 1926. The greatest decreases were in gold ore, 87 per cent; lead ore, 83 per cent; and lead-copper ore, 50 per cent. Copper ore shipped crude to smelters increased 26 per cent.

Miscellaneous materials, classed as tailings, which were treated by cyanidation, amalgamation, leaching, and smelting in 1927 amounted to 74,144 tons, a decrease of 28 per cent as compared with 1926. The yield from tailings and mine water in 1927 was 1,035.24 ounces of gold, 21,651 ounces of silver, 1,602,396 pounds of copper, and 282,985 pounds of lead.

Metallurgic recovery of metals in California in 1927, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated [1]	563, 999	210, 580. 03	47, 667			
Tailings amalgamated	2, 130	336. 56	164			
Ore cyanided	14, 630	30, 263. 08	147, 034			
Concentrates cyanided	3, 812	12, 215. 34	3, 419			
Tailings cyanided	1, 510	250. 14	1, 290			
Ore smelted	58, 998	3, 590. 24	164, 078	3, 278, 081	1, 302, 088	
Concentrates smelted:						
Flotation	55, 254	16, 941. 69	1, 156, 882	22, 251, 075	298, 472	8, 062, 625
Other	2, 417	7, 579. 86	58, 608	1, 456	834, 469	
Tailings smelted	70, 504	448. 54	20, 197	[2] 1, 602, 396	282, 985	
		282, 205. 48	1, 599, 339	27, 133, 008	2, 718, 014	8, 062, 625

[1] Includes gold and silver from "high grade" as follows: 12,235.36 ounces of gold and 2,440 ounces of silver.

[2] Includes copper from mine water.

Mine production of metals from gold and silver mills in California in 1927, by counties

County	Ore, tailings, etc., treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Tailings, etc.	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Amador	265, 626	660	75, 249. 53	15, 221	63. 84	39
Butte	15		9. 07	5		
Calaveras	16, 053		4, 026. 00	853	6. 29	3
Eldorado	3, 801	10	2, 763. 53	523		
Fresno	86		38. 94	5		
Inyo	140	1, 010	27. 66	17	99. 36	57
Kern	22, 156	1, 450	6, 638. 26	2, 402	908. 90	12, 678
Lassen	50		25. 69	16		
Madera	274		189. 73	58		
Mariposa	12, 361		8, 443. 27	2, 096		
Mono	749		4. 06	4	12. 47	14, 101
Monterey	20		24. 18	4		
Napa	3, 351				334. 13	90, 988
Nevada	192, 012		70, 969. 25	18, 315	28, 727. 45	29, 003
Placer	2, 919		2, 672. 28	496		
Plumas	3, 478		433. 64	120		
San Bernardino	3, 283	500	615. 65	191	263. 45	1, 408
San Diego	2, 085		436. 91	123		
Shasta	288		466. 02	64		
Sierra	32, 785	10	31, 017. 27	5, 600		
Siskiyou	7, 691		4, 497. 03	674		
Trinity	4, 598		469. 40	631		
Tuolumne	4, 166		1, 721. 59	386	97. 33	47
Yuba	642		177. 63	27		
	578, 629	3, 640	[1] 210, 916. 59	[1] 47, 831	30, 513. 22	148, 324
Total, 1926	675, 095	2, 300	[1] 241, 247. 79	[1] 47, 785	36, 942. 42	304, 144

County	Concentrates and recovered metal			
	Concentrates produced	Gold	Silver	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
Amador	4, 526	17, 330. 42	4, 649	
Calaveras	36	160. 53	75	4, 460
Eldorado	39	193. 29	51	
Kern	5	53. 36	62	
Mariposa	57	223. 64	286	
Napa	17	15. 87	8, 544	
Nevada	210	861. 74	927	
San Bernardino	80	92. 07	8, 123	
San Diego	32	118. 92	39	
Shasta	2	34. 23	7	
Sierra	61	488. 36	192	
Tuolumne	24	32. 39	83	
	5, 089	19, 604. 82	23, 038	4, 460
Total, 1926	6, 633	26, 797. 33	7, 509	1, 151

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[1] Includes gold and silver from "high grade" as follows: 1927, 12,235.36 ounces of gold and 2,440 ounces of silver; 1926, 20,687.89 ounces of gold and 3,798 ounces of silver.

Mine production of metals from concentrating mills in California in 1927, by counties

County	Ore to concentrating mills	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Amador	200	15	58.70	11			
Calaveras	5,854	927	8.18	441	396,949		
Imperial	50	5	12.44	5	47		
Inyo	9,870	1,024		23,859		820,654	
Los Angeles	14,679	2,070		26,116		296,692	1,351,375
Mono	25	2	6.29	30		1,092	
Plumas	724,827	41,332	14,122.83	315,650	21,055,404		
San Bernardino	34,868	2,355	2,587.95	758,685	1,409	8,263	
Shasta	24,266	8,664	335.68	71,074	798,722	1,780	6,711,250
	814,639	56,394	17,132.07	1,195,871	22,252,531	1,128,481	8,062,625
Total, 1926	919,190	88,361	13,464.86	1,346,561	28,645,592	1,887,815	20,350,860

Mine production of metals from California concentrates in 1927

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Amador	4,541	17,389.12	4,660			
Calaveras	963	168.71	516	396,949	4,460	
Eldorado	39	193.29	51			
Imperial	5	12.44	5	47		
Inyo	1,024		23,859		820,654	
Kern	5	53.36	62			
Los Angeles	2,070		26,116		296,692	1,351,375
Mariposa	57	223.64	286			
Mono	2	6.29	30		1,092	
Napa	17	15.87	8,544			
Nevada	210	861.74	927			
Plumas	41,332	14,122.83	315,650	21,055,404		
San Bernardino	2,435	2,680.02	766,808	1,409	8,263	
San Diego	32	118.92	39			
Shasta	8,666	369.91	71,081	798,722	1,780	6,711,250
Sierra	61	488.36	192			
Tuolumne	24	32.39	83			
	61,483	36,736.89	1,218,909	22,252,531	1,132,941	8,062,625
Total, 1926	94,994	40,262.19	1,354,070	28,645,592	1,888,966	20,350,860

BY KINDS OF CONCENTRATES

Dry gold	5,012	19,568.02	6,387	47	4,460	
Dry silver	2,440	2,695.71	775,234	1,409		
Copper	42,326	14,132.35	316,288	21,463,995	1,780	
Lead	1,278	6.47	44,167		1,091,409	
Zinc	10,427	334.34	76,833	787,080	35,292	8,062,625
	61,483	36,736.89	1,218,909	22,252,531	1,132,941	8,062,625

Mine production of metals from California crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pound*
Butte	1	0. 61	82	40	130	
Calaveras	1, 031	16. 14	102	54, 129		
Eldorado	60	4. 02	3			
Inyo	2, 819	337. 13	49, 512	24, 790	1, 058, 984	
Kern	234	591. 25	592			
Mariposa	1	2. 62	2			
Mono	93	143. 67	24, 265	95	3. 810	
Nevada	5	27. 16	11			
Riverside	216	72. 18	3, 385	17, 119	121, 867	
San Bernardino	2, 890	382. 92	20, 169	192, 228	117, 297	
Shasta	34, 844	987. 00	47, 026	2, 255, 924		
Trinity	16, 800	1, 004. 50	18, 923	733, 756		
Tuolumne	4	21. 04	6			
	58, 998	3, 590. 24	164, 078	3, 278, 081	1, 302, 088	
Total, 1926	63, 651	5, 321. 23	286, 411	3, 099, 167	5, 855, 224	83, 027

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry gold	586	970. 81	1, 065	659		
Dry silver	1, 152	56. 34	53, 475	16, 892	1, 261	
Copper	54, 685	2, 171. 20	67, 611	3, 238, 548	116, 036	
Lead	2, 382	322. 81	38, 544	8, 596	1, 062, 924	
Lead-copper	193	69. 08	3, 383	13, 386	121, 867	
	58, 998	3, 590. 24	164, 078	3, 278, 081	1, 302, 088	

REVIEW BY COUNTIES

ALPINE COUNTY

Mining activities in Alpine County in 1927 were confined to prospecting and developing work. A lead-silver gold vein was discovered at the summit of Ebbitt Pass, but the only production of metals reported in the county came from tailings of the Curtz property.

AMADOR COUNTY

Amador County ranked third in the production of gold in 1927 and fourth in the value of all metals. The total output from 15 lode and 8 placer mines was valued at $1,934,033.

Six properties in the vicinity of Jackson produced 194,803 tons of ore, which yielded 67,880.78 ounces of gold and 14,505 ounces of silver. The Argonaut and Kennedy mines were worked continuously during the year. The Argonaut shaft is developed by an incline shaft 5,530 feet long and the Kennedy by a vertical shaft 4,764 feet deep. The incline shaft at the Moore mine was sunk to the 2,100-foot level and the mine was under development the entire year. The Sunset mine was operated the early part of the year, followed by some development, but was shut down in October.

The Yellow Tiger Consolidated Mining Co. took possession of the Pioneer (Cassinelli) gold lode mine near Pine Grove in the Volcano district and made a good production. The mine was operated steadily after June 1, with the exception of a short period when a breakdown was being repaired. The Elephant hydraulic mine, operated during the water season, handled about 12,000 cubic yards of gravel. The Defender was reopened and equipment installed.

The Plymouth mine, the only one operating in the vicinity of Plymouth, continued active under the management of the Argonaut Mining Co., and a new ore body was opened. There was some production from cyaniding the Plymouth tailings.

The Central Eureka mine at Sutter Creek operated full time but was hampered in its development work by encountering a faulted zone on the 4,500-foot level. According to the annual report of the Central Eureka Mining Co., the recovery per ton of ore treated was $7.8835 and the average assay value of the tailings was $1.1031, making the total average value $8.9866; the recovery was 87.725 per cent. The concentrates averaged $72.059 a ton. The incline shaft of the Central Eureka is 4,700 feet deep. Surface placers in the Sutter Creek district yielded 22.51 ounces of gold. The Keystone and North Star mines were closed during 1927. The American mine was unwatered.

BUTTE COUNTY

The value of the metals produced in Butte County in 1927 was not as large as in 1926, although the number of lode and placer mines operated was practically the same. The total yield in 1927 was valued at $143,878, of which $143,616 was from placer mines, mostly worked by dredges.

Drift mines in the Chico district, including the Badger, Kelly Hill, Lillian, and Red Rock, and small sluice operations, yielded 162.75 ounces of gold.

A notable feature of the dredging industry in Butte County was the change of ownership of the Feather River Dredge No. 1, which was first operated in December, 1906. This dredge was sold to the Shasta Butte Gold Dredging Co. in August by C. H. Thurman, who had purchased it from the Natomas Co. of California in 1925.[7] The Holton dredge on Feather River, operated by Lawrence Gardella, burned in June.

Interest was revived in the drift mines of Magalia Ridge by the developments of the Genii Mining Co., which is said to have acquired nearly 500 acres of the Mammoth channel and which plans extensive operations. The Butterfly, Dix, Golden Pool, and Lucky John drift mines and the Cherokee sluice placer yielded between 30 and 60 ounces of gold each.

CALAVERAS COUNTY

The value of the metals produced in Calaveras County in 1927 was materially less than that of 1926 because of the cessation of activities by the Calaveras Copper Co. in January. The value of the total output of metals in 1927 was $299,194, as compared with $1,316,821 in 1926, the greatest loss being in the copper. The yield of gold and silver from placer mines increased from $66,860 in 1926 to $129,125 in 1927.

A clean-up was again made about the Old Penn mine; production was recorded from the Finnegan mine at Carson Hill. The Royal mine at Felix was under operation by the Finnegan Mining Co. for a part of the year and milled about 1,200 tons of ore. Some tests made at the Demarest mine resulted in production, and development work at the Thorpe and Backman mines at Fourth Crossing was continued. A final clean-up at the Melones mill of the Carson Hill property was made in January, 1927; mining operations closed in December, 1926. The production of this property is said to have been about $5,000,000 between 1918 and 1922.[8] The Gwinn lode, between Valley Springs and Mokelumne Hill, the Carlton, and the Foltz, near Westpoint, each yielded over 100 ounces of gold. The Foltz mine was shut down in June by the Hammon interests.

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[7] Young, G. J., California Gold Dredge in Operation Over Twenty Years: Eng. and Min. Jour., vol. 123, No. 26, 1927, pp. 1042–1046.

In the vicinity of Angels Camp the Calmo, Monarch, and Victor drift placers yielded nearly 350 ounces of gold. The Blue Lead and Green Mountain drift mines, near Mokelumne Hill, and some small sluice operations produced almost 500 ounces of gold. The main placer production of the county was from the Isabel dredge on Calaveras River near Jenny Lind and from the Vallecito Western drift mine between Angels Camp and Vallicita, where considerable development work was under way.

Development work was carried on at the Wagon Rut mine, near Angels Camp, and the Union Mines (Inc.) was sinking a shaft and drifting for the ancient channel on its property near Mokelumne Hill. At the Pioneer Chief, near San Andreas, machinery was installed, and work of opening up the shaft was begun.

DEL NORTE COUNTY

The only production of gold in Del Norte County in 1927 came from hydraulic operations at the Myrtle Creek mine near Crescent City.

ELDORADO COUNTY

The value of the gold and silver produced in Eldorado County in 1927 was $82,637—$9,624 less than in 1926.

The Sliger property near Greenwood, where much development work was carried on, was the most active of the lode mines. A rich pocket was found near Georgetown. Other productive mines were the Kelsey, Montezuma, Overlook and Snark, and the Pyramid. Some drifting and crosscutting was done at the Martinez mine, near El Dorado; a small force of men was developing the Neptune mine near Georgetown; and the Slate Mountain mine near Placerville was being cleaned out and retimbered. About 800 feet of drifting was done at the Hines Gilbert property, near Greenwood.

Sluicing operations in the vicinity of Georgetown yielded over 124 ounces of gold, and those near Placerville over 137 ounces. The chief placer operations of the county were at the Hook and Ladder and the Blue Channel drift mines near Smithflat; the Pine Hill, Yellow Jacket, and Elizabeth drift mines were also producers.

FRESNO COUNTY

The gold and silver produced in Fresno County in 1927 was derived mainly as a by-product from the operations of the Service Rock Co. and the Grant Rock & Gravel Co., although about 40 ounces of gold came from lode mines and a little from small sluicing operations. The total yield of gold and silver for the county in 1927 was $17,483.

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[8] Moss, F. A., The Geology of Carson Hill: Eng. and Min. Jour., vol. 124, No. 26, 1927, pp. 1010–1012.

HUMBOLDT COUNTY

Three hydraulic operations near Orleans in Humboldt County yielded over 64 ounces of gold in 1927; the balance of the gold output was won by sluicing in the vicinity of Weitchpec. The total gold and silver yield of the county in 1927 was valued at $1,743.

IMPERIAL COUNTY

A small production of gold, silver, and copper was reported from the Good Luck and Gunsight lode mines near Ogilby in 1927.

INYO COUNTY

Twenty-five lode mines and one placer in Inyo County yielded metals having a total value of $197,673 in 1927, as compared with $639,444 in 1926. The decrease was due mainly to the cessation of mining activities at the lead-silver mines because of the low prices of the metals. One sluicing operation near Independence yielded 20 ounces of bullion.

The Cerro Gordo property continued its production of lead-silver ore, and the Santa Rosa lead mine was taken over and operated by the United States Smelting, Refining & Mining Co. The Silver Reef mine in the Cerro Gordo district was operated the latter half of the year. The American Metals (Inc.) continued its operations at the Darwin property, a consolidation of the Defiance, Independence, Lucky Jim, Lane, and Promontory, and was the largest producer of lead ore in the county. A considerable yield of silver and lead was made from the Darwin dump. The Eclipse copper and North Star lead mines were other producers in the Darwin district. J. W. Ehrman shipped one car of lead ore from the Lead-Lode and was making preparations for continuous work for the next two years. There were several shippers of one car each of lead ore from properties near Keeler, Laws, and Shoshone. The Engineers Exploration Corporation operated the Ophir [9] mine near Trona from January to July and extended its main shaft to a depth of 514 feet. The Tecopa properties at Tecopa were shut down in October after a long period of production. Activities in the Ubehebe district resulted in a production of over 330,000 pounds of lead.

Development work was encouraging at the Earnestina mine, near Independence, and some ore was mined and put on the dump at the Cleveland, near Big Pine. The Estelle Mines Corporation at Darwin confined its work to driving a drift to reach an ore body opened up and partly exploited. Work on the tailings of the Slate Range property will probably result in a production in 1928.

KERN COUNTY

The value of gold and silver produced in Kern County in 1927 was $180,032, as compared with $140,175 in 1926. One silver mine reported a production; surface placers yielded over 20 ounces of gold; and the rest of the output of gold and silver was derived from gold lode mines.

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[9] Fox, J. M., Developing a Prospect: Eng. and Min. Jour., vol. 123, No. 122, 1927, pp. 883-888.

The Zenda mine in the Amalie district was a large producer and was developed further. Five mines in the Mojave district yielded over 1,150 ounces of gold; the Yellow Dog was the principal producer. The Tropico mine, although producing, was not as active as in previous years.

The Randsburg district was more active than any other part of the county; 12 lode mines in this district produced ore yielding 6,355.46 ounces of gold and 1,749 ounces of silver. The chief producers in order of rank in gold yield were the Yellow Aster, the Big Gold (Butte), the Windy, the Big Butte, and the King Solomon. The Baash-Ross Tool Co. built a combination concentrating and amalgamating mill at Osdick, which treated several lots of custom ore during the year; the mill was removed late in 1927.

Little new development work was undertaken in the county. The old Keyes property near Isabella was being cleaned out and retimbered.

LASSEN COUNTY

The only production of gold and silver recorded in Lassen County in 1927 came from the Blue Bell lode claim at Hayden Hill. The total value of the output was $540.

LOS ANGELES COUNTY

The Black Jack and Renton lead-zinc mines of the Santa Catalina Island Co. were closed in July on account of the continued low prices of lead and zinc. Lead and zinc ore [10] has been shipped from these mines since 1924; more recently the zinc concentrates have been sent to Belgium. The value of all metals produced in the county in 1927 was $122,344; gravel pit workings near Azusa contributed about 100 ounces of gold as a by-product.

MADERA COUNTY

Gold and silver produced in Madera County in 1927 was valued at $4,219, as compared with $1,730 in 1926. The lode mines yielded the larger part of the output. An article on the magnetite deposits of the Minarets Mountains contains a reference to the geology of Madera County.[11]

MARIPOSA COUNTY

The output from 17 lode mines and 16 placers in Mariposa County was valued at $185,181 in 1927, as compared with $183,831 from 19 lode mines and 14 placers in 1926.

The chief producer of the county was the Original lode mine, at Clearinghouse, which was operated throughout the year on a basis of two 8-hour shifts. More than 11,500 tons of ore was milled, and 1,500 feet of drifting along the vein north of the shaft was completed. The Duncan mine, near Hornitos, shipped several lots of bullion recovered from selected ore but was closed down in July. Small lodes in the Mount Bullion district, including the Greenstone, the Jumper and Bear claims, and the King Midas, yielded over 200 ounces of gold. The

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[10] Gieser, H. S., Mining and Milling on Santa Catalina Island: Eng. and Min. Jour., vol. 124, No. 7, 1927, pp. 245–247.

[11] Dougherty, E. Y., Magnetite Deposits of Madera County, Calif., Constitute Important Reserves: Eng. and Min. Jour., vol. 123, No. 19, 1927, pp. 765–770.

Virginia mine near Coulterville was reopened, and preparations were made for mining early in 1928. The operators of the Buena Vista and Washington claims in the Hite district east of Coulterville began blocking out ore with the expectation of mining and milling in 1928. In some sections of the county, particularly the Briceburg and Whitlock districts, more interest was shown than in the past.

Sluicing operations in the vicinity of Coulterville yielded 130.55 ounces of gold, and those in the vicinity of Hornitos 46.88 ounces. The Trinity Mining Co. carried on some experimental work near Merced Falls; this resulted in a small production.

MONO COUNTY

The metals produced in Mono County in 1927 all came from lode mines and were valued at $25,829, or $117,768 less than in 1926.

A shipment of gold ore was made from the Sierra Vista mine. Miscellaneous activities about Bodie, Hammil, and Masonic resulted in some production. The Silverado mine, west of Sweetwater, Nev., was the largest producer in the county, operating from August 15 to the end of the year.

There was considerable prospecting north of Mono Lake, but most of the activity among the small mines was confined to assessment work. The Serita mine at Masonic was closed, but it is expected to be opened again in 1928.

MONTEREY COUNTY

The Holly Berry lode mine, 25 miles west of Jolon, was the only producer of gold and silver in Monterey County in 1927; it was also a producer in 1926. The ore was milled in a Huntington mill on the property. Prospect work was done on the Mariposa and on the Oregon and Cool Spring claims in the Los Burros district. A few tons of ore was saved while drifting on the New York mine, but no ore was milled in the 10-stamp Straub mill.

NAPA COUNTY

The property of the Palisades Mines Co., near Calistoga, was operated by the Palisades Leasing Syndicate until May; during this time 3,351 tons of silver ore was shipped. Development work was done on the Palisades and Easley veins.

NEVADA COUNTY

The value of the mine production of gold and silver in Nevada County decreased from $2,348,861 in 1926 to $2,154,776 in 1927.

Lode mines in the Grass Valley district yielded 95,852.90 ounces of gold and 47,348 ounces of silver from 191,462 tons of ore, produced largely by the Empire, Idaho-Maryland, and North Star mines. The St. Louis lode was the chief producer in the vicinity of Nevada City; the Twin Sisters mine was operated throughout the year and made a small production during development work. The Mizpah at North Bloomfield produced 300 tons of ore, yielding 103 ounces of bullion. The Eagle Bird and Gaston lodes at Washington were also producers.

The annual report of the North Star Mines Co. for the fiscal year ended December 31, 1927, states:

> During the year the production of the North Star mine was $881,319.59, with outlays for current operation amounting to $755,608.88. The actual amount spent for development was $144,992.97 * * *.
>
> The year's output came chiefly from rock mined on and between the 6,900 and 8,600 levels on the so-called X vein and the 6,600 and 6,900 levels on the No. 2 vein. A total of 129,814 tons (including 8,000 tons from development) was delivered to the sorting plant, of which 21,114 tons was discarded as waste, leaving 108,700 tons crushed, with an average yield of $8.11 per ton crushed, at an average cost of $6.95 for operating and $1.45 for development, making an aggregate cost of $8.40 per ton and resulting in a loss of 29 cents per ton. The yield per ton in 1927 was 25 cents more, and the cost 61 cents less, than in the previous year.
>
> Of the total production of the year 70.16 per cent was obtained in the mill by amalgamation, while 29.84 per cent was recovered by cyanidation. It is estimated that the value lost in the tailings was 35 cents per ton crushed.
>
> Development work was carried on throughout the year to the extent of 6,485 feet (drifts 4,371 feet, raises 1,518 feet, shaft-raise 300 feet, crosscuts 215 feet, and switch 81 feet), 3,285 feet on the X and 3,200 feet on the No. 2 vein. The 8,600 level was extended eastward 1,743 feet from the bottom of the vertical shaft and in November (1927) connected with the bottom of the No. 2 shaft by raise 300 feet in distance. The main project for the development of the mine in depth, undertaken several years ago, was then completed, the vertical shaft having been sunk to 3,600 feet, and the two incline shafts connected therewith on the 8,600 level. * * * In spite of the disappointing results of last year's business, it may be pointed out that the mine produced nearly $900,000, that there was a reduction in costs of 61 cents a ton, and that both veins have produced ore in their downward extension, in the case of the X to the 8,600, and of the No. 2 to the 7,200 level.

The Alcalde gold lode near Grass Valley was merged with a new company, and they expected to start operations early in 1928 after a shutdown since 1923. The Brunswick mine was closed, and no production was reported from the Champion. A shaft was sunk 200 feet on the Gracie-Glencoe-Flat Ledge property, near Nevada City, and repairs were being made at the Le Compton mine and mill. It was reported that the New England Consolidated Mine would operate the Nevada City Consolidated property at an early date.

Sluicing operations at the Gold Fleece and Slide placers, near French Corral, yielded less than 70 ounces of gold. The Stockdale and Porter hydraulic property, about 3 miles north of Grass Valley, was operated by the International Rare Metals Recovery Co., which was later reorganized into the Deer Creek Placer Mining Co. Four placers in the vicinity of Nevada City, the Liberty Hill hydraulic, Graham Bros. drift, the Loyal drift, and the Tom and Jerry sluice, yielded 442.81 ounces of gold and 88 ounces of silver. Wear Bros.' return from drift gravel mining on their property 5 miles from Washington was considerable, and placers in the You Bet district, including the Amundsen, the Browns Hill, and the Quaker Hill, yielded 448.90 ounces of gold and 36 ounces of silver.

PLACER COUNTY

The yield of gold and silver in Placer County was about equally divided between its lode mines and placers, although there were 40 placer operations and only 6 lode mines. The value of the metals produced was $97,934, or $14,667 more than in 1926.

The production from the lode mines came from the Beauty, Annie Laurie, Four Aces, from a test run at the Australia, and from some prospecting in the vicinity of McKeon. The Four Aces was the largest producer of the county.

Placers in the vicinity of Auburn yielded 418.38 ounces of gold and 53 ounces of silver, mostly from the Colfax dredge, which was dismantled in May. Small sluice operations were carried on near Colfax, and the Trixie sluice mine, near Dutch Flat, was operated throughout the year. Drift placers in the vicinity of Foresthill yielded over 56 ounces of gold. Placers near Iowa Hill, mostly drift, produced 174.90 ounces of gold; the Gleeson, Star United, and Twenty-One were the largest of these. In the Last Chance district development work on the Black Hawk channel resulted in saving gravel which yielded over 100 ounces of gold. About an equal amount of gold was won from the Glenn drift workings. The Home Ticket and Pacific Consolidated placer was a producer. Most of the mining operations around Michigan Bluff were drifting; this method yielded 150 ounces of gold.

PLUMAS COUNTY

Copper is the most valuable metal of Plumas County mines. In 1927 the county yielded 21,055,404 pounds, valued at $2,758,258, as compared with 22,163,035 pounds, valued at $3,102,825 in 1926. The combined value of gold, silver, and copper produced in Plumas County in 1927 was $3,258,382, and the county was second to Yuba County, which produces only gold and silver. There were 9 lode mines operating in both 1927 and 1926 and 40 placer operations in 1927, as compared with 14 placers in 1926, but the yield in placer gold and silver was not as large in 1927 as in the previous year.

The Engels Copper Mining Co. continued its lead in the tonnage of ore treated in the county, followed as in 1926 by the Walker Mining Co. The following is quoted from the fourteenth annual report of the Engels company:

> *Production and metal sales.*—The concentrating mill treated 384,671 tons of ore during the year of an average copper content of 1.788 per cent, as compared to 1.785 per cent for 1926. Mill operation resulted in recovery of 88.14 per cent of copper content of the ore or 31½ pounds per ton milled.

METALS PRODUCED AND SOLD, 1927

12,121,756 lbs. copper at 12.9148¢ per lb	$1, 565, 502. 52
125,177 ozs. silver at 56.5579¢ less 5% per oz	67, 257. 32
1,712 ozs. gold at $19.00 per oz	32, 526. 69
Gross value of production	1, 665, 286. 53

COST OF COPPER PRODUCTION IN 1927

		Total cost	Cost per pound
Operating cost		$919, 354. 10	7. 5843¢
Freight and smelting charges	$571, 487. 53		
Credit by gold and silver	99, 784. 01		
		471, 703. 52	3. 8914¢
		1, 391, 057. 62	11. 4757¢
Operating and marketing cost		77, 968. 71	. 6432¢
Add development and exploration amortization		273, 249. 94	2. 2542¢
Total cost of copper production		1, 742, 276. 27	14. 3731¢

> Operating and marketing cost compares favorably with last year. The large amount written off against income for mine development and exploration this year accounts for the increased final cost per pound of copper produced. Cost

> per ton of ore handled is actually less than last year as will be seen from comparative statement below:

	1927		1926	
		Cost per ton		*Cost per ton*
Ore ..... tons	384,671	.....	421,618	.....
Mining cost	$498,091.68	$1.2949	$584,114.92	$1.3854
Milling cost	259,974.23	.6758	285,751.69	.6777

> *Mine development.*—* * * In the course of development and exploration during the year there was driven 8,161 feet of drifts, 4,667 feet of raises, 78 feet of shaft sinking and 19,980 feet of diamond drilling. Electrical prospecting has also been employed to some extent.

The report of the Anaconda Copper Mining Co. for the year ended December 31, 1927, states with regard to the Walker mine:

> Operations at the Walker mine were conducted throughout the year. Three hundred and eighty-five thousand eight hundred and nineteen tons of ore were broken. The concentrator made an average recovery of 92.696 per cent. Three hundred and forty thousand one hundred and fifty-six tons of ore, averaging 1.49 per cent copper, were treated, from which 19,268.41 tons of concentrates, averaging 24.388 per cent copper, were produced. There were sold to the smelter 19,406.62 tons of ore and concentrates yielding 8,701,138 pounds of copper, 180,950.32 ounces of silver, and 12,410.83 ounces of gold.

In the Greenville district 2,065 tons of ore, yielding 362.01 ounces of gold and 86 ounces of silver, was mined from the Arcadian, Moore, and New York properties. A clean-up of the mill yard at the Plumas-Eureka was made, and 1,243 tons of ore from the Gold Leaf Consolidated at Spring Garden was mined and treated. At the Jamison lode mine, near Johnsville, 666 feet of development work, mainly drifting and crosscutting, was done. A concentrating mill was erected at the Golden Mary property, and preparations were made for resumption of work at the Buckhorn gravel mine near Spring Garden during the winter of 1927–28. No other extensive development work in the county was reported.

Placer mining centered mainly about La Porte, Quincy, and Seneca; there was little activity at Johnsville or on Squirrel Creek. In the La Porte district the Iron Bound hydraulic, Marguerite drift, Plumas Sierra drift, Southern hydraulic, and some small operations yielded 497.08 ounces of gold and 39 ounces of silver. Small hydraulic and sluice operations near Quincy yielded 82.72 ounces of gold and 14 ounces of silver; the Glazier drift and Pioneer sluice mines, with a small output from the Sunnyside at Seneca, yielded 137.60 ounces of gold and 10 ounces of silver. The Twelve Mile Bar drift placer near Twain was operated from January to August.

RIVERSIDE COUNTY

The Mecca property (Mileta claims), 47 miles from Mecca, shipped lead-copper ore and was the only large producer in the county. A property near Inca shipped one lot of copper ore. The total yield of metals from the county in 1927 was valued at $13,332.

Activity at the Los Angeles-Brooklyn gold and silver property near Mecca was reported to begin early in 1928, and development work was carried on at the Black Hawk gold-silver-lead property near Perris.

SACRAMENTO COUNTY

The gold and silver output in Sacramento County in 1927 came entirely from dredge operations in the Natoma field and was valued at $1,212,750, as compared with $1,305,673 in 1926. The annual report of the Natomas Co. of California for the year ended December 31, 1927, states:

> The results of dredging operations for the year were briefly as follows:
>
> | | |
> |---|---|
> | Cubic yards of material dredged | 13, 877, 394 |
> | Gross gold recovered | $1, 200, 997. 17 |
> | Operating costs, including taxes and insurance | 854, 662. 33 |
> | Net | 346, 334. 84 |
>
> The gross returns for the year averaged 8.65 cents per cubic yard, which was 0.88 cent per cubic yard less than during the preceding year, while the operating costs of 5.89 cents per cubic yard was 0.25 cent less than during 1926.

The Capital Dredging Co. put one dredge in operation in the Natoma field in 1927, and a second boat was under construction.

The G. A. Bower property on the American River opposite Folsom was leased for a period of five years, and development work was in progress.

SAN BERNARDINO COUNTY

The production of silver has been closely associated with mines in San Bernardino County since the discovery of the California Rand Silver property in 1919 but has been falling off since 1925. The entire silver yield of the county in 1927 was 788,580 ounces, valued at $447,125; the value of all metals produced in 1927 was $562,626, as compared with $696,825 in 1926.

Four lead properties in the vicinity of Cima shipped 162 tons of ore which yielded 58,067 pounds of lead. Silver ore was shipped from the Carbonate King property in the Clark Mountains. Ore from the Monarch Rand mine on Fremont Peak was milled by the Pittsburg Milling Co. Copper ore, aggregating 1,897 tons and containing 206,214 pounds of copper, was shipped from the Run Over Consolidated group near Goffs. One car of copper ore was shipped from the Bagdad Chase property, and a shipment of copper ore was made from the Alice and Reliance group near Vidal.

The Santa Fe, Silver Glance, and Uranium silver mines, the chief mines in operation on the San Bernardino side of the Randsburg district, produced 35,699 tons of ore yielding 758,287 ounces of silver and 2,715.57 ounces of gold. The Silver Lake and Victorville districts shipped some lead ore, and several gold mines near Victorville, particularly the Black Hawk, were productive. Although silver bullion was obtained from the Yermo and Calico districts and more interest was shown in the Calico section than for some time, these camps were not particularly productive.[12]

At the Gold King mine near Goffs a shaft was sunk. At the Rentchler group of 13 lode claims in the Silver Mountain the hoist was overhauled, dump tracks were relaid, and levels were driven and cleaned preparatory to resumption of active mining. Development work was going on at the Copper Hill and Lucky Dog groups near Ivanpah. Preparations were made for installing a large mill at the General Gold Point Mines property near Victorville. The Christmas Gold Quartz Mining Co. did some development work at its property near Randsburg.

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[12] The Mining Review, Once Famous Silver-Lead Camp North of Daggett, Calif., Being Groomed to Eclipse Early Day Sensational Performance: Oct. 15, 1927, p. 9.

Some dry washing operations in the county yielded 35.59 ounces of gold.

SAN DIEGO COUNTY

The metal output of San Diego County in 1927 was gold and silver from lode mines and was valued at $11,582, as compared with $11,437 in gold, silver, lead, and zinc in 1926. The Golden Chariot mine in the Julian district was the largest producer in 1927; the rest of the production of the county came from the Eagle, Granite Mountain, and Stonewall mines, also in the Julian district. The Ready Relief group was unwatered by the Hollywood Gold Mines Co. (Inc.). Other work in the county was confined to assessment work.

SHASTA COUNTY

Shasta, the second largest county in the State in production of copper and the first in output of zinc in 1927, yielded $1,284,556 in gold, silver, copper, lead, and zinc as compared with $2,287,323 in 1926. This large decrease was due to the suspension of activities in August by the California Zinc Co. at the Afterthought, Rising Star, and Copper City mines on account of the low price of zinc. The Mountain Copper Co., operating at the Hornet and Iron Mountain mines at Keswick, and the Mason Mining Co., at the Balaklala near Kennett, were the only large copper-producing companies in the county at the end of 1927. A clean-up of copper tailings was made at the Mammoth property.

Four gold lode mines in the vicinity of French Gulch—the Halcyon, Niagara, Summit Gulch, and Washington—produced 455.58 ounces of gold and 63 ounces of silver. The Summit Gulch was worked steadily throughout the year; it is reported that its dividends to the end of 1927 amounted to $5,035.

One hundred tons of ore was milled at the Milkmaid mine the latter part of the year. Preparations were made for the installation of a small mill at the Black Diamond property. The Greenhorn copper mine was taken over by new people who undertook to clean up the property with a view to operating in 1928. A new mill was being built at the Mad Ox mine.

The three dredges in Shasta County yielded by far the larger part of the placer gold won in the county. The Horsetown dredge, formerly operated by L. Gardella, was taken over by the Shasta Butte Gold Dredging Co. in July; a new dredge near Cottonwood was in operation; and the Clear Creek dredge was run by Mr. Gardella throughout the year. The Triangle surface placer made the largest individual output of bullion aside from that by the dredges.

SIERRA COUNTY

The lode mines of Sierra County contributed the larger part of the bullion yield of the county. The total value in gold and silver was $682,223 from 12 lode and 21 placer mines in 1927, as compared with $567,365 from 11 lode and 22 placer mines in 1926.

The Gold Dollar, Original Sixteen to One, and the Plumbago were the chief lode mines operating in the vicinity of Alleghany. Working of the Tightner tailings resulted in a yield of 78.71 ounces of gold and 14 ounces of silver. The Bessler mine at Downieville was a producer, as were the Brush Creek and Young America at Forest. Ore was milled at and shipped from the Bigelow mine at Sierra City, and a small test run was made at the Monarch, which was worked under lease by J. D. Tilford. At the El Dorado mine, near Alleghany, retimbering and cleaning out of drifts was under way, and additions were made to the mill. Some development work was done at the Sovereign-Comet gold mine near Downieville. Work at the York-Finney mine at Downieville gave some encouragement. Only prospecting was done at the Kate Hardy mine near Forest. At the Gibraltar Sierra Mining Co.'s property, 8 miles southwest of Johnsville, the 2,100-foot tunnel to tap the ancient river channel was driven 1,700 feet. Plans were made for future tunneling at the St. Charles Hill drift mine.

Two hydraulic mines near Camptonville, the Depot Hill and Indian Hill, were producers. Placer operations near Downieville, of which the Brandy City (sluice) and Ruby (drift) were the largest producers, yielded 197.43 ounces of gold and 20 ounces of silver. A large nugget was uncovered by sluicing 1 mile west of Goodyears Bar. The Syndicate Hydraulic Mines (Inc.) was active at its property on Slate Creek at the foot of Table Rock Mountain. Hydraulic operations continued at the Hilda and Pride placers near Sierra City, and for six months of 1927 Mr. Thomas carried on sluicing and drifting at the Washington placer, on the South Branch of North Yuba River. Considerable equipment was planned for a diversion dam built in December, 1926, at the Goodyear Bar placer which is to be worked by hydraulic methods. The Blue Gravel mines near Strawberry Valley were further prospected by drifting, but no production was made.

SISKIYOU COUNTY

Activity in Siskiyou County is confined chiefly to hydraulic placer mining, although the yield from gold lode mines in 1927 was more than twice as large as that from placers. The output of gold from hydraulic mines was 1,642.11 ounces and that from surface or sluice operations 576.39 ounces. The value of all gold and silver produced in Siskiyou County in 1927 was $139,408, or $2,541 less than in 1926.

The largest lode operations were at the Golden Eagle and New York near Yreka, Morrison and Garlock near Cecilville, and Independence mine 12 miles below Happy Camp; these mines yielded 4,152 ounces of gold and 612 ounces of silver. Small lodes contributing to the gold yield were the Oh Boy at Fort Jones, Iron Must near Hawkinsville, Nigger Boy at Hornbrook, and Boss near Sawyers Bar.

Hydraulic properties producing more than 100 ounces of gold each in 1927 were, in order of rank, the Oro Fino, Gallia, Eddy's Gulch, and Gold Bank and John Frank mines; those producing about 50 ounces were the Kunz Flat, Ten Eyck, Paddy Cronin, Witch Stick, Wike, and Rider and Fabricius. Many small operations resulted in the sales of bullion to the stores and banks of the county.

No new or extensive development work was reported in Siskiyou County during the year. The Portuguese Flat hydraulic, between

Hamburg and Seiad, was not worked but was expected to be in operation in 1928. Small operations were under way at the Roxbury hydraulic at Scott Bar.

STANISLAUS COUNTY

The metal output of Stanislaus County was gold and silver from placer mines—mainly from the one dredge on Tuolumne River, near La Grange, which was operated throughout the year. The Atlas Rock Co. obtained gold bullion as a by-product from its sand and gravel workings on the Stanislaus River near Oakdale.

TRINITY COUNTY

The value of the gold, silver, and copper output in Trinity County in 1927 was $517,940, compared with $603,204 in 1926. There were decreases in all metals, although the number of placer mines reporting was larger than in 1926. The Island Mountain mine was the largest producer and the only copper mine in the county, followed by the United Trinity property, near Carrville, which produced gold ore. Small shipments of gold bullion were made from the Betty Hebbard, Hazel D, and Ozark, and some gold was produced from small lodes near Minersville.

Placer operations in Trinity County in 1927 were confined mostly to hydraulic mines, although the output of gold bullion from 42 hydraulic placers was not as large as that from the 3 dredges of the county. Drift mining yielded over 100 ounces of gold, and surface workings a small output. The three drift mines reporting were the Prince Albert near Coffee, the Appletree near Dedrick, and the Bed Rock Tunnel near Junction City. Two dredges, the Lewiston and Trinity, were in full operation throughout the year; the Estabrook Dredging Co., however, suspended operations in August and the dredge was dismantled.

The principal hydraulic work near Junction City was at the Jacobs mines, which were worked from January to the middle of July. At Lewiston, Waldo and Mead shipped from the Bablew hydraulic, and J. Anderson & Co. had a clean-up from the Cobb hydraulic. Near Weaverville the Costa, Gem, Hook and Ladder, Mulligan, and Union Hill were productive hydraulic mines; small hydraulic workings in the vicinity yielded 1,071.11 ounces of gold and 106 ounces of silver.

About 60 feet of tunneling was done at the Brown Fox near Coffee, and although the Holland placer was idle all season work was expected to be renewed in 1928. Efforts were made to prove values at the Garden hydraulic at Junction City, and new capital was interested in the La Grange mining ground, 2 miles from Weaverville. Only small development work at other properties was reported.

TUOLUMNE COUNTY

The output from mines in Tuolumne County was materially less than that of 1926. The value of the gold and silver yield in 1927 was only $40,511, as compared with $121,318 in 1926. Many small lode mines, particularly in the vicinity of Sonora, were productive. The gold won from the placers came from sluicing operations in the vicinity of Columbia, Jamestown, and Sonora.

Two pockets near Big Oak Flat yielded over 43 ounces of gold by hand mortaring. No milling was done at the Clio Vindicator near Jacksonville and the mine was idle, although a clean-up was made about the property. From the Harriman in the same vicinity 300 tons of low-grade ore was mined. In the Columbia district four lodes produced 315.31 ounces of gold and 58 ounces of silver, which came chiefly from the Ham and Birney property, a pocket enterprise, and the Republic mine, whose plant was practically rebuilt during 1927. At Jamestown the Jumper and Golden Rule, Norwegian, a mine on the Valponi Ranch, and a pocket mine yielded more than 221.50 ounces of gold. The Fifty-Five mine near Merced Falls treated 200 tons of $10 ore. Small lodes in the Tuolumne district, including the Casa Madera, Red Cloud, Spring Gulch, and three others, yielded 92.92 ounces of gold and 28 ounces of silver. The Mark Twain at Sonora, the Experimental and the Ham and Birney near Columbia, and the Fifty-Five were the largest individual producers of gold bullion in the county. The plant at the Mark Twain was shut down April 30, 1927. The Experimental property was under the management of two different organizations during the year, and it is understood that a new company has been formed for operating in 1928. In Tuolumne County are many small prospects and pocket workings, the yield from which is sold through the banks, and is therefore difficult to trace to a definite source.

Development work only was done at the Springfield and Richards drift mines, 3½ miles west of Sonora. Although no production was made at the Saratoga drift property, some work was going on there most of the year. The Arizona pocket mine was believed to have been worked out. A 5-stamp mill was erected at the Belcher lode mine near Jamestown, and 50 feet of drifting was done; the Andres-Rives Development Co. was developing the Humbug drift, 2 miles west of Jamestown. It was reported that the Cherokee gravel mine, 2 miles north of Tuolumne, was about ready to start production. Many of the mines in the county remained closed.

YUBA COUNTY

The output of gold and silver in Yuba County is almost entirely from dredges. The total yield from all sources in 1927 was valued at $3,474,944, an increase of $698,854 over the value in 1926. Lode mines near Challenge produced 642 tons of ore, which yielded 177.63 ounces of gold and 27 ounces of silver. Some new development on a lode property near Browns Valley was done, but no definite results had been realized by the end of the year.

GOLD, SILVER, COPPER, AND LEAD IN OREGON

(MINE REPORT)

By JAMES M. HILL[1]

SUMMARY

The total value of the mine production of gold, silver, copper, and lead in Oregon in 1927 was $393,657, an increase of 18 per cent as compared with 1926. The value of the gold increased 11 per cent, silver 40 per cent, and copper 54 per cent, but that of lead decreased 64 per cent as compared with 1926. The output in 1927 came from 36 lode mines and 150 placer mines, as compared with 49 lode mines and 100 placers in 1926.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

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[1] Helen M. Gaylord, of the Bureau of Mines, prepared the statistics for this report.

Mine production of gold, silver, copper, and lead in Oregon, 1918–1927

Year	Mines producing		Ore and tailings (short tons)	Gold		Silver		Copper		Lead		Total value
	Lode	Placer		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1918	42	78	126, 681	61, 458. 74	$1, 270, 465	107, 323	$107, 323	2, 451, 016	$605, 401	10, 601	$753	$1, 983, 942
1919	23	55	96, 173	47, 303. 25	977, 845	111, 121	124, 455	2, 214, 815	411, 955			1, 514, 255
1920	20	47	82, 156	49, 221. 08	1, 017, 490	82, 743	90, 190	2, 355, 276	433, 371			1, 541, 051
1921	23	84	40, 333	42, 668. 39	882, 034	42, 120	42, 120	174, 300	22, 485			946, 639
1922	44	126	27, 522	25, 714. 60	531, 568	151, 812	151, 812	1, 046, 525	141, 281	76, 970	4, 233	828, 894
1923	55	151	50, 385	24, 091. 14	498, 008	96, 322	78, 984	1, 283, 476	188, 671	27, 523	1, 927	767, 590
1924	43	71	44, 842	26, 695. 36	551, 842	38, 103	25, 529	768, 395	100, 660	513	41	678, 072
1925	53	94	27, 483	18, 982. 80	392, 409	32, 793	22, 758	106, 325	15, 098	5, 612	488	430, 753
1926	49	100	21, 727	13, 243. 10	273, 759	29, 733	18, 553	296, 454	41, 504	11, 549	924	334, 740
1927	36	150	26, 839	14, 676. 16	303, 383	45, 830	25, 986	488, 200	63, 954	5, 300	334	393, 657

Gold and silver produced at placer mines in Oregon, 1918–1927

Year	Dredge				Drift				Hydraulic				Surface				Total value
	Gold		Silver		Gold		Silver		Gold		Silver		Gold		Silver		
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	
1918	18, 756. 91	$387, 740	3, 336	$3, 336	360. 35	$7, 449	53	$53	4, 170. 17	$86, 205	559	$559	815. 36	$16, 855	154	$154	$502, 351
1919	14, 355. 29	296, 750	2, 934	3, 286	63. 90	1, 321	12	13	3, 628. 90	75, 016	671	752	365. 90	7, 564	53	59	384, 761
1920	17, 360. 05	358, 864	3, 939	4, 294					4, 286. 22	88, 604	889	969	176. 52	3, 649	25	27	456, 407
1921	18, 477. 32	381, 960	3, 617	3, 617					4, 272. 09	88, 312	577	577	409. 30	8, 461	97	97	483, 024
1922	13, 060. 94	269, 994	2, 452	2, 452	58. 05	1, 200			2, 773. 68	57, 337	393	393	851. 69	17, 606	166	166	349, 148
1923	10, 841. 66	224, 117	1, 649	1, 352	93. 47	1, 932	13	11	1, 812. 89	37, 476	321	263	640. 73	13, 245	79	65	278, 461
1924	14, 104. 08	291, 557	2, 024	1, 356	31. 05	642	8	5	1, 026. 99	21, 230	153	103	587. 92	12, 153	94	63	327, 109
1925	6, 641. 04	137, 282	741	514	15. 96	330	3	2	1, 337. 07	27, 640	197	137	1, 043. 31	21, 567	190	132	187, 604
1926	3, 589. 00	74, 191	378	236	253. 10	5, 232	51	32	1, 407. 24	29, 090	218	136	689. 08	14, 245	196	122	123, 284
1927	5, 449. 11	112, 643	590	335	13. 99	289	2	1	2, 078. 95	42, 976	320	181	1, 344. 31	27, 789	243	138	184, 352

GOLD

Oregon mines produced 11 per cent more gold in 1927 than in 1926. Lode mines yielded 39 per cent and placer mines 61 per cent of the total gold in 1927, as compared with 55 per cent and 45 per cent in 1926 and 52 per cent and 48 per cent, respectively, in 1925. The production of gold from lode mines in 1927 was 21 per cent less than in 1926.

Grant County in 1927 maintained first place in lode-gold production, and Josephine County took second place, supplanting Baker County which had led in production prior to 1926 when it was supplanted by Grant County. Baker County ranked third in 1927.

The yield of gold from placer mines in 1927 increased 50 per cent as compared with 1926. Dredge yield increased 52 per cent. Dredges produced 61 per cent of the total placer gold saved in 1927. Gold saved at placer mines worked by the drift method in 1927 amounted to less than 0.2 per cent of the total placer yield. Hydraulic mines in 1927 produced 23 per cent of the total placer gold; their output was 48 per cent greater than in 1926. The gold yield from surface workings in 1927 was 95 per cent greater than in 1926.

Grant County also maintained its lead as a producer of placer gold; more than 90 per cent of the county's placer output in 1927 was saved by dredging. Baker County was again second in yield of placer gold, and Josephine County was again third.

The five largest gold-producing mines in Oregon in 1927, in order of output, were: Empire (dredge) and Buffalo-Monitor (gold lode), in Grant County; Superior (dredge) and Ben Harrison (gold lode), in Baker County; Progressive (gold lode), in Josephine County.

Of the total gold output of Oregon in 1927, 34 per cent came from dry gold ore and tailings, 5 per cent from copper ore, 37 per cent from dredges, 14 per cent from hydraulic mines, 9 per cent from surface placers, and a few ounces from drift mining. Of the gold produced at lode mines 28 per cent was saved by amalgamation, 8 per cent by smelting ore, 62 per cent by the smelting of flotation concentrates, and 2 per cent by smelting old dump materials. No gold from Oregon mines was saved by cyanidation in 1927.

SILVER

In 1927 the mine production of silver in Oregon increased 54 per cent in quantity and 40 per cent in value as compared with 1926. Lode mines yielded 97 per cent and placer mines 3 per cent of the total silver output in 1927, as in 1925 and 1926. Gold ore and tailings yielded 79 per cent and copper ore 18 per cent of the silver produced in 1927. Three mines, with a production of over 1,000 ounces of silver each, contributed 95 per cent of the total silver yield of the State.

Grant County was again first in rank, and Baker County again second. No other county produced as much as 600 ounces of silver in 1927.

Of the silver produced from lode mines in 1927, 10 per cent was recovered by smelting ore, 88 per cent by smelting flotation concentrates, 1 per cent by smelting tailings, and nearly 1 per cent by amalgamation.

COPPER

The mine production of copper in Oregon in 1927 increased 65 per cent in quantity and 54 per cent in value as compared with 1926. The Homestead Iron Dyke mine was producing all the year.

Copper was produced in 1927 in Baker and Grant Counties, named in order of output. Ninety per cent of the copper produced in 1927 was from smelting flotation concentrates and nearly 10 per cent from smelting ore. Practically all the copper was from copper ore.

LEAD

In 1927 the mine production of lead in Oregon decreased 54 per cent in quantity and 64 per cent in value as compared with 1926. All the lead came from ore classed as siliceous gold ore and was recovered from concentrates sent to smelters. The entire output came from Grant County, particularly from the Granite district.

Mine production of gold, silver, copper, and lead in Oregon in 1927, by counties

County	Mines producing		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	13	30	1,019.31	$21,071	2,962.18	$61,234	3,981.49	$82,305
Coos		3			14.14	292	14.14	292
Curry	2	3	29.93	619	18.82	389	48.75	1,008
Douglas	1	4	6.82	141	31.08	642	37.90	783
Grant	5	24	3,621.11	74,855	3,777.80	78,094	7,398.91	152,949
Jackson	4	23	38.69	800	543.19	11,229	581.88	12,029
Josephine	10	58	1,070.34	22,126	1,460.99	30,201	2,531.33	52,327
Malheur	1	4	3.60	74	59.60	1,232	63.20	1,306
Wheeler		1			18.56	384	18.56	384
	36	150	5,789.80	119,686	8,886.36	183,697	14,676.16	303,383
Total, 1926	49	100	7,304.68	151,001	5,938.42	122,758	13,243.10	273,759

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	8,465	$4,800	483	$274	8,948	$5,074
Coos			1	1	1	1
Curry	4	2	1	1	5	3
Douglas			2	1	2	1
Grant	35,780	20,287	400	227	36,180	20,514
Jackson	8	5	71	40	79	45
Josephine	328	186	184	104	512	290
Malheur	90	51	9	5	99	56
Wheeler			4	2	4	2
	44,675	25,331	1,155	655	45,830	25,986
Total, 1926	28,890	18,027	843	526	29,733	18,553

Mine production of gold, silver, copper, and lead in Oregon in 1927, by counties—Continued

County	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
Baker	486, 480	$63, 729			$151, 108
Coos					293
Curry					1, 011
Douglas					784
Grant	1, 720	225	5, 300	$334	174, 022
Jackson					12, 074
Josephine					52, 617
Malheur					1, 362
Wheeler					386
	488, 200	63, 954	5, 300	334	393, 657
Total, 1926	296, 454	41, 504	11, 549	924	334, 740

Gold and silver produced at placer mines in Oregon, 1926 and 1927, by counties

County	Dredge		Drift		Hydraulic		Surface		Total value
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	
1926		*Fine ounces*		*Fine ounces*		*Fine ounces*		*Fine ounces*	
Baker	$16, 305	99	$5, 073	50	$2, 960	62	$3, 376	109	$27, 914
Coos					129	1	507	3	639
Curry							1, 390	12	1, 397
Douglas					1, 837	2	368	3	2, 208
Grant	57, 886	279	159	1	486	7	4, 412	37	63, 145
Jackson					7, 370	51	1, 422	13	8, 832
Josephine					15, 045	83	2, 046	13	17, 151
Malheur					1, 200	10	392	4	1, 601
Marion							332	2	333
Wheeler					63	2			64
	74, 191	378	5, 232	51	29, 090	218	14, 245	196	123, 284
1927									
Baker	40, 071	238	85	2	10, 559	130	10, 519	113	61, 508
Coos					152	1	140		293
Curry							389	1	390
Douglas					231		411	2	643
Grant	72, 572	352	204		2, 400	16	2, 918	32	78, 321
Jackson					8, 584	52	2, 645	19	11, 269
Josephine					19, 807	111	10, 394	73	30, 305
Malheur					859	6	373	3	1, 237
Wheeler					384	4			386
	112, 643	590	289	2	42, 976	320	27, 789	243	184, 352

MINING INDUSTRY

The supply of water in Oregon in 1927 was fair, and placer mines were much more productive than in 1926. The two dredges, one in Baker and one in Grant County, were able to run full time. Hydraulic mine output was much larger in all counties except Douglas and Malheur. Surface miners were more numerous, and their efforts were more successful than in 1926, except in Grant, Malheur, and Marion Counties and on the beaches in Coos and Curry Counties.

The total metal output of mines in Oregon increased materially in 1927. Copper increased 65 per cent in quantity over 1926, following an increase of 179 per cent in 1926 over 1925, but lead declined 54 per cent in quantity in 1927 as compared with 1926. Production revived in the Susanville-Galena and Granite districts in Grant County. In Baker County the Homestead Iron Dyke mine was on a producing basis all the year; the Bay Horse silver mine was idle, but there was considerable activity near Durkee, Lime, Malheur, Sumpter, and Whitney. In southwestern Oregon there was much development under way at a number of mines in Jackson, Josephine, and Douglas Counties. Little gold and platinum were produced on the beaches of Coos and Curry Counties.

A 7-cubic-foot dredge was planned to operate on a large consolidated acreage on Foots Creek, a few miles west of Gold Hill, Jackson County.

Ore and tailings sold or treated in Oregon, 1921–1927, with content in terms of recovered metals

Year	Ore and tailings	Gold	Silver	Copper	Lead
DRY GOLD ORE					
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
1921	37,935	19,075.66	36,490		
1922	6,449	6,189.97	15,250	10,749	1,276
1923	29,472	7,506.11	25,515	3,301	857
1924	29,855	8,941.37	18,352	1,143	513
1925	24,561	9,554.34	20,369	205	4,016
1926	16,094	6,742.07	22,146	3,043	11,549
1927	10,625	4,977.88	36,376	1,720	5,300
DRY SILVER ORE					
1921					
1922	3,956	8.76	119,146	23,587	75,694
1923	1,973	14.30	46,234	18,221	26,666
1924	156	2.20	4,778	2,543	
1925	182	16.02	9,352	520	1,596
1926	1	.29	262		
1927					
COPPER ORE					
1921	2,398	434.02	1,339	174,300	
1922	17,117	2,771.51	14,405	1,012,189	
1923	18,940	3,181.98	22,511	1,261,954	
1924	14,831	2,001.75	12,694	764,709	
1925	2,740	375.06	1,941	105,600	
1926	5,632	562.32	6,482	293,411	
1927	16,214	811.92	8,299	486,480	

Ore and tailings sold or treated in Oregon in 1927, with content in terms of recovered metals

Source	Mines producing	Ore and tailings		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore and tailings	34	10,625	39.59	4,977.88	33.92	36,376	79.37
Copper ore	2	16,214	60.41	811.92	5.53	8,299	18.11
Total, lode mines	36	26,839	100.00	5,789.80	39.45	44,675	97.48
Total, placers	150			8,886.36	60.55	1,155	2.52
	186	26,839	100.00	14,676.16	100.00	45,830	100.00
Total, 1926	149	21,727		13,243.10		29,733	

Source	Copper		Lead	
	Pounds	Per cent	Pounds	Per cent
Dry gold ore and tailings	1,720	0.35	5,300	100.00
Copper ore	486,480	99.65		
	488,200	100.00	5,300	100.00
Total, 1926	296,454		11,549	

Ore and tailings sold or treated in Oregon in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	304	207.39	166		
Curry	5	29.93	4		
Douglas	1	6.82			
Grant	[1] 9,836	3,621.11	35,780	1,720	5,300
Jackson	60	38.69	8		
Josephine	[2] 418	1,070.34	328		
Malheur	1	3.60	90		
	10,625	4,977.88	36,376	1,720	5,300
Total, 1926	16,094	6,742.07	22,146	3,043	11,549

COPPER ORE

County	Ore and tailings	Gold	Silver	Copper	Lead
Baker	16,214	811.92	8,299	486,480	
	16,214	811.92	8,299	486,480	
Total, 1926	5,632	562.32	6,482	293,411	

[1] Includes 5 tons of tailings.

[2] Includes 120 tons of tailings.

METALLURGIC INDUSTRY

The total quantity of material treated at gold mills in Oregon in 1927 was only 21 per cent of that treated in 1926. No ore or concentrates were treated by cyanidation in Oregon in 1927. Ore amalgamated in 1927 decreased 63 per cent, compared with 1926, and ore smelted decreased 68 per cent, but concentrates smelted increased 69 per cent.

The gold recovered by amalgamation was 49 per cent less than in 1926; gold recovered by smelting ore decreased 81 per cent, but that by smelting concentrates increased 530 per cent.

Silver recovered at amalgamation mills was 32 per cent less than in 1926. Ore smelted in 1927 yielded 78 per cent less and concentrates smelted 864 per cent more silver than in 1926.

Copper recovered by smelting ore in 1927 was 32 per cent less than in 1926, but that recovered by smelting concentrates was 94 per cent more.

All the lead recovered in 1927 was from smelting concentrates, whereas all the output in 1926 was from smelting ore.

Metallurgic recovery of metals in Oregon in 1927, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ore amalgamated	3,260	1,588.36	301		
Tailings amalgamated		4.64	53		
Ore smelted	292	474.42	4,374	46,973	
Concentrates (flotation) smelted	1,775	3,617.05	39,486	441,197	5,300
Tailings smelted	125	105.33	461	30	
		5,789.80	44,675	488,200	5,300

Mine production of metals from ore treated at gold and silver mills in Oregon in 1927, by counties

County	Ore	Recovered in bullion			
		Amalgamation		Cyanidation	
		Gold	Silver	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Baker	301	167.75	69		
Douglas	1	6.82			
Grant	2,600	400.99	133		
Jackson	60	38.69	8		
Josephine	298	974.11	91		
	3,260	1,588.36	301		
Total, 1926	15,565	3,105.20	522	1,092.58	3,991

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Grant	182	1,377.67	7,427	1,481	5,300
	182	1,377.67	7,427	1,481	5,300
Total, 1926	3	20.00	10		

Mine production of metals from concentrating mills in Oregon in 1927, by counties

County	Ore to concentrating mills	Concentrates and recovered metal			
		Concentrates produced	Gold	Silver	Copper
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
Baker	16,018	1,236	805.03	7,513	439,716
Grant	7,144	357	1,434.35	24,546	
	23,162	1,593	2,239.38	32,059	439,716
Total, 1926	5,238	1,049	553.97	4,088	227,691

Mine production of metals from Oregon concentrates in 1927

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	1,236	805.03	7,513	439,716	
Grant	539	2,812.02	31,973	1,481	5,300
	1,775	3,617.05	39,486	441,197	5,300
Total, 1926	1,052	573 97	4,098	227,691	

BY KINDS OF CONCENTRATES

Dry gold	539	2,812.02	31,973	1,481	5,300
Copper	1,236	805.03	7,513	439,716	
	1,775	3,617.05	39,486	441,197	5,300

Mine production of metals from Oregon crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	199	41.89	830	46,764	
Curry	5	29.93	4		
Grant	87	399.00	3,450	209	
Malheur	1	3.60	90		
	292	474.42	4,374	46,973	
Total, 1926	924	2,532.93	20,279	68,763	11,549

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry gold	96	467.53	3,588	209	
Copper	196	6.89	786	46,764	
	292	474.42	4,374	46,973	

REVIEW BY COUNTIES

BAKER COUNTY

There were 19 surface placers, 8 hydraulic mines, 2 drift mines, and 1 dredge on a production basis in Baker County in 1927; they yielded bullion to the value of $61,508, of which the dredge produced nearly two-thirds. Of the 13 lode mines producing in 1927, 11 treated gold ore and 2 shipped copper ore. The lode mines produced 16,518 tons of ore, yielding metals valued at $89,600, of which 71 per cent was in copper, 24 per cent in gold, and 5 per cent in silver. Of the total ore produced 98 per cent was copper ore. The largest individual production of gold was made by the Superior dredge near Bridgeport. The Homestead Iron Dyke mine produced more silver and copper than any other mine in the county.

At Bridgeport the Superior dredge and the Cottonwood hydraulic property were productive.

In the Connor Creek district the Connor Creek group (sluice) and Fair View claims (lode) were the only producers.

At Cornucopia the Last Chance and Union mines, which have been large producers of gold bullion, were closed all year; a small gold production was made by drifting at the Boulder Creek mine.

In the Greenhorn district, southwest of Baker, the Rabbitt lode was reopened under lease by Woodward & Littlefield, and 40 tons of ore was milled in the 5-stamp amalgamation mill. One hydraulic and two sluice mines produced bullion carrying over 462 ounces of gold and 117 ounces of silver. The Banner group was reopened, but no ore treated in 1927.

The Yellow Metal hydraulic mine at Hereford was prospected by D. K. Worsham, and the Tom Tom hydraulic by the Wyant brothers.

At Homestead the Homestead Iron Dyke mine was operated by the Idaho Copper Corporation, which sunk 200 feet of shaft and completed over 2,000 feet of drifting and raises. The 150-ton flotation mill was remodeled, and during the eight months of operation 16,203 tons of ore was milled; this ore carried nearly all of the copper produced in the State. The Lime Peak Copper Co. of Homestead made a small shipment of copper ore. The Carnahan group of claims on Snake River, 10 miles below Homestead, was extensively developed by the B. and O. Mining Co., but no ore was shipped in 1927.

The Denson sluice mine on Pine Creek near Robinette made a fair production.

At Rye Valley the Rainbow Mining Co. made a small shipment of gold ore. The Cartwright and Spring Gulch hydraulic mines were operated.

The United Consolidated Group in the Sanger district was under development by Record and Dennison, and a few tons of gold ore was milled.

A little gold was recovered by snipers working on Snake River near Huntington.

In the Sparta district the Macy, Moratte, and Paddy Creek lode mines were in operation. The combined production was 180 tons of ore yielding over 28 ounces of gold and 9 ounces of silver. Prospecting and development work was continued on the properties of the Oregon Copper Co. and the Daddy Lode Copper Co.

In the Sumpter district the Buck Gulch hydraulic, the Three Cent drift, and several small sluice operations, with a clean-up of old materials from the abandoned Powder and Sumpter dredges, netted bullion carrying 63 ounces of gold and 68 ounces of silver. Development was continued at the Imperial Eagle mine.

The Whited group at Unity was worked by the Payton brothers, who milled a few tons of ore.

In the Weatherby district the Gleeson and Little Bonanza lodes were operated by A. V. Lovejoy, and the Hallock lode by N. M. Hallock.

In the Whitney district the Blue Bucket and Mayflower hydraulic mines and the Parkerville surface placer were producers, netting 20.41 ounces of gold and 4 ounces of silver. The Bonanza lode was under development by Frank Dodson, but no ore was milled or shipped.

COOS COUNTY

In Coos County during 1927 the largest placer-gold production came from the Bray Mountain hydraulic mine near Myrtle Point. A few ounces of gold was saved at the Nugget Patch beach mine near Powers and by other small beach operations.

CURRY COUNTY

In Curry County a total of 18.82 ounces of gold was saved at beach mines near Gold Beach and Sixes. The Mule Mountain lode near Marial, under development by the Billings brothers, and the Robert E lode mine near Chetco were productive.

DOUGLAS COUNTY

The Douglas surface placer on Cow Creek, the Morning Star hydraulic mine on Lees Creek, the Tuller hydraulic in the Ruben district, and some snipers who sold their gold at Myrtle Creek produced bullion carrying over 31 ounces of gold and 2 ounces of silver. The Diamond Butte lode on Cow Creek, near Glendale, made a small production from ore taken out during development.

GRANT COUNTY

At Austin the Caraboo hydraulic and the Moore placer made a small production.

The Quartz Gulch hydraulic and Sunshine sluice mines near Canyon City and five small placer operations produced bullion carrying over 114 ounces of gold and 15 ounces of silver. The Miller Mountain Mining Co., operating the Pittsburg mine, milled 500 tons of gold ore.

In the Granite district the Big Nugget hydraulic mine made a small production. The Buffalo-Monitor group of lode mines, operated by R. G. Amidon & Co., produced siliceous concentrates as well as bullion. The Monumental lode was extensively developed by the Monumental Mining Co. A pilot flotation mill was built and run for a few months, and work was started in the fall on a 50-ton mill. Development was under way at the Ajax mine, but no ore was milled or shipped. The Boston and Lucky Strike mines were operated for a few months by W. C. Fellows but were later abandoned.

The Ben Harrison mine in the Greenhorn district was operated by the C. L. Morris Construction Co. during 1927 and 100 feet of drifting was done. The 150-ton flotation mill was second in the State in quantity of ore milled in 1927.

At John Day the Dickey lode mine was productive; 88 ounces of bullion was sold to a local merchant.

At Prairie City the Hidden Treasure placer was productive, the Empire dredge was operated throughout the year, and several snipers sold bullion. The Equity Copper & Gold Mining Co.'s properties were worked under bond by J. H. Dunstan.

In the Galena-Susanville district the Bear Creek drift placer was operated by the Pierson Bros. The Oriole-Monitor group of lode claims, 1 mile west of Susanville, was developed by the Thompson Mining Co., of Chehalis, Wash.; the Badger-Bull of the Woods group was under development by the Yakima Badger Mining Co., who installed a 50-ton ball mill. The Black Hawk-Side Issue lode claims were being opened by the Black Hawk Mining Co.

JACKSON COUNTY

In the Applegate district, west of Jacksonville, the Federal, Sterling, and Vance hydraulic mines and 8 sluice operations produced 285.59 ounces of gold and 33 ounces of silver. The Pacific hydraulic in Ferris Gulch was not productive, as the long drain cut was not finished. The Big Four, Great I Am, Reed and Fletcher, and Gore lode mines milled 60 tons of ore that yielded bullion carrying 39 ounces of gold and 8 ounces of silver. The Opp mine was under development.

The Black Gold, Durkin, Boling, and Pankey hydraulic mines, on Foots Creek, and two surface mines produced bullion carrying 176.73 ounces of gold and 23 ounces of silver. Negotiations were concluded for the consolidation of several holdings in the lower part of Foots Creek, and plans were drawn for the building of a dredge to be managed by D. M. Ferry, of Gold Hill. None of the quartz mines near Foots Creek or Gold Hill were productive, and almost no work was done on lode mines in the district. The Sylvanite lode mine was taken over by the Revival Mining Co.

The Huston hydraulic mine near Willow Springs, west of Central Point, was producing; several small operators sold their gold through Medford banks.

The Lance Bros.' hydraulic mine, near Rogue River, was operated; a few ounces of bullion was saved by snipers in this district.

JOSEPHINE COUNTY

The Enterprise and May Queen hydraulic mines in the Althouse district were productive in 1927.

At Galice the Dean and Dean hydraulic had a good run; 10 small placer operators sold their gold through Carpenter's store. The total placer production of the district was 221 ounces of gold and 23 ounces of silver. A small amount of bullion was taken from the Oriole and Teddy lode mines. At the Sugar Pine (or Golden Wedge) property, 4 miles north of Galice, operated by J. W. Nance after August, 1927, some bullion was recovered in milling tests on ore taken out during development. The Progressive (or Robertson) mine was the largest producer of gold in southwest Oregon. The Alameda mine was idle; development was continued on the Western Metal properties.

In the vicinity of Grants Pass and the country tributary thereto 30 small placer miners produced a total of 389 ounces of gold and 66 ounces of silver, which was sent to the mint through the two local banks. The Swastika hydraulic made a small production. The Golden Mary mine and the Humdinger milled 75 tons of fair-grade ore. The mill at the Golden Mary did not prove efficient and was removed, but development continued at the mine. The Oregon Metal Corporation continued development on the Jewett mine, 3 miles southeast o Grants Pass.

On Jumpoff Joe Creek the Workman hydraulic was producing.

In the Kerby district four placer mines, including the Adams hydraulic, produced over 120 ounces of gold and 13 ounces of silver.

The Greenback mine near Leland was under development part of the year, and over 100 tons of concentrates produced some years ago were shipped to a smelter. The Stevenson hydraulic was a producer.

The Wilken placer in the lower Applegate district was productive. Few of the mines near Murphy were worked during the year, except for assessment, although the Oscar Creek and Watts hydraulic mines made quite a run.

In the Mount Ruben district, north of Galice, the Grubstake mine was opened by William Mokos and made a good production. At the Mount Ruben mine 640 feet was driven in the long crosscut tunnel, making it now 6,250 feet.

The Cow Boy and Queen of Bronze copper mines in the Takilma district were reported under option to Spokane (Wash.) interests; some development was done, but no ore or concentrates were shipped.

In the Waldo district the Llano De Oro and Logan hydraulic mines were producing. The total placer yield of the district was more than 600 ounces of bullion. The long drain tunnel and ditch at the Llano De Oro was nearly completed, and with the excellent equipment at the property it should make a large production in 1928. J. T. Logan operated two giants at the Logan mine, his hydraulic property.

In the Wolf Creek district the Ruble hydraulic was operated by C. E. Forsythe, owner, and by Davis and Miller, lessees. The Thompson lode mine was worked by F. C. Livingstone; the 5-ton Chilean mill was run for 20 days and made a fair clean-up.

LANE COUNTY

No production was made by mines in the Bohemia district in 1927, and very little development was done. Near the end of the year there was more activity, indicating a revival of mining in the district.

LINN COUNTY

Mines in the Quartzville district on Santiam River were not productive and for the most part were not operated in 1927.

MALHEUR COUNTY

The Jed Blair hydraulic mine and three small surface placers in the Mormon Basin district between Malheur and Vale produced approximately 60 ounces of gold and 9 ounces of silver. The Jones mine in Jordan Valley made a small shipment of ore carrying considerable silver. The Red, White, and Blue and the Sunday Hill lode mines in Mormon Basin were under development but did not ship.

MARION COUNTY

No mines in Marion County reported production in 1927.

WHEELER COUNTY

The Gold Medal hydraulic mine near Antone was the only producing mine in Wheeler County in 1927.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

The Homestake gold mine, at Lead, Lawrence County, has been producing almost continuously since 1875 and is now the largest producing gold mine in the United States. Ore from this mine to the company's mills amounted to 1,371,583 tons in 1927—44,192 tons less than in 1926—but the revenue from the sale of gold-silver bullion bars amounted to $6,679,802.31 in 1927—$867,858.41 more than in 1926. The other producing mines in South Dakota in 1927 were one lode mine in the Keystone district, Custer County, and two small sluice placer mines—one near Tinton, Lawrence County, and the other near Hill City, Pennington County. In 1926 also, in addition to the Homestake, there was one other producing lode mine (small) and two small producing sluice mines. The following table shows the number of producing mines, tons of ore produced, and recovered content of metals in South Dakota from 1918 to 1927, inclusive:

Mine production of gold, silver, copper, and lead in South Dakota, 1918–1927 [1]

Year	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
1918	16	6	22	1, 782, 563	317, 598. 18	$6, 565, 337	159, 202	$159, 202
1919	9	3	12	1, 330, 368	235, 249. 57	4, 863, 040	116, 493	130, 472
1920	3	4	7	1, 356, 189	226, 224. 23	4, 676, 470	90, 795	98, 966
1921	3	6	9	1, 725, 685	319, 524. 95	6, 605, 167	112, 464	112, 464
1922	3	3	6	1, 751, 454	315, 297. 99	6, 517, 788	118, 760	118, 760
1923	5	--------	5	1, 665, 439	309, 905. 05	6, 406, 306	95, 844	78, 592
1924	4	--------	4	1, 674, 720	295, 930. 24	6, 117, 421	86, 548	57, 987
1925	3	--------	3	1, 590, 079	289, 747. 10	5, 989, 604	96, 133	66, 716
1926	2	2	4	1, 415, 785	279, 528. 93	5, 778, 376	82, 186	51, 284
1927	2	2	4	1, 376, 583	322, 031. 74	6, 656, 987	96, 171	54, 529

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1918	64, 806	$16, 007	53, 408	$3, 792	$6, 744, 338
1919	----------	----------	32, 547	1, 725	4, 995, 237
1920	----------	----------	12, 812	1, 025	4, 776, 461
1921	----------	----------	4, 000	180	6, 717, 811
1922	----------	----------	----------	----------	6, 636, 548
1923	----------	----------	----------	----------	6, 484, 898
1924	----------	----------	----------	----------	6, 175, 408
1925	----------	----------	----------	----------	6, 056, 320
1926	----------	----------	----------	----------	5, 829, 660
1927	----------	----------	138, 000	8, 694	6, 720, 210

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[1] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. 1, p. 42, and Mineral Resources, 1922, pt. 1, p. 194.

Gold and silver produced at placer mines in South Dakota, 1918–1927

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1918	20.85	$431	---------	---------	$431
1919	19.16	396	1	$1	397
1920	27.91	577	5	5	582
1921	89.44	1,849	7	7	1,856
1922	87.99	1,819	7	7	1,826
1923–1925	---------	---------	---------	---------	---------
1926	6.43	133	---------	---------	133
1927	14.46	299	---------	---------	299

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages for each year of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091
1919	1.12	.186	.053	.073
1920	1.09	.184	.080	.081
1921	1.00	.129	.045	.050
1922	1.00	.135	.055	.057
1923	$0.82	$0.147	$0.070	$0.068
1924	.67	.131	.080	.065
1925	.694	.142	.087	.076
1926	.624	.140	.080	.075
1927	.567	.131	.063	.064

MINING AND METALLURGIC INDUSTRY

Production at the Homestake mine was continuous during 1927. A review of the Homestake and other operations is noted under the review by counties.

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1918–1927

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1918	1,628,630	202,219.02	55,932	12,252
1919	1,192,588	146,815.80	41,595	9,000
1920	1,274,944	148,018.30	42,863	8,660
1921	1,620,588	214,003.69	60,604	22,500
1922	1,663,525	218,247.50	58,806	7,500
1923	1,652,337	216,907.61	60,624	10,725
1924	1,674,720	203,174.24	52,920	7,625
1925	1,589,711	195,865.49	49,812	7,500
1926	1,415,785	187,119.66	47,284	5,625
1927	1,371,583	208,952.00	52,480	14,188

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1918–1927

Year	Material treated			Gold in bullion	Silver in bullion	Sodium cyanide used
	Crude ore	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1918	152, 732	1, 565, 809	1, 718, 541	115, 234. 34	97, 849	370, 218
1919	136, 893	1, 157, 945	1, 294, 838	86, 017. 98	72, 662	284, 653
1920	81, 135	1, 245, 419	1, 326, 554	78, 062. 93	44, 456	339, 122
1921	49, 047	1, 620, 588	1, 669, 635	105, 360. 12	50, 811	395, 228
1922	87, 929	1, 620, 699	1, 708, 628	96, 962. 50	59, 947	387, 683
1923	13, 087	1, 626, 234	1, 639, 321	92, 960. 74	35, 135	361, 900
1924		1, 647, 344	1, 647, 344	92, 756. 00	33, 628	361, 650
1925		1, 567, 555	1, 567, 555	92, 528. 61	32, 005	347, 242
1926		1, 402, 472	1, 402, 472	92, 402. 84	34, 902	299, 672
1927		1, 353, 298	1, 353, 298	113, 058. 32	41, 005	312, 626

Mine production of metals from South Dakota crude ore shipped to smelters, 1918–1927

Year	Crude ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
1918	901	122. 47	4, 525	64, 806	11, 536
1919	247	2, 386. 11	1, 615		3, 792
1920	110	115. 09	3, 471		12, 812
1921	157	71. 70	1, 042		4, 000
1922					
1923	15	36. 70	85		
1924					
1925	368	1, 353. 00	14, 316		
1926–27					

REVIEW BY COUNTIES

CUSTER COUNTY

Mine production of gold, silver, and lead in Custer County, S. Dak., 1918–1927

Year	Mines producing		Ore	Gold (lode and placer)	Silver (lode and placer)	Lead	Total value
	Lode	Placer					
			Short tons		*Fine ounces*	*Pounds*	
1918	1		300	$31	896	41, 872	$3, 900
1919	1		440	27	483	25, 962	1, 944
1920							
1921		3		582	1		583
1922–1925							
1926		1		30			30
1927	1		5, 000	144	2, 686	138, 000	10, 361

There were no producing placer mines in Custer County in 1927.

In 1926 the Spokane Silver & Lead Co. reopened the Spokane-Cuyahoga property, 17 miles from Custer and 6 miles from Keystone. The mill was remodeled in 1927, and lead concentrates were made by flotation from November, 1927, until January 3, 1928, when a fire destroyed the power plant and the mill and mine shut down. The ore is a lead-zinc-gold-silver-copper sulphide A nearly vertical shaft, 325 feet deep, with levels at 100, 200, and 300 feet, opens the property.

The mill is a 100-ton plant equipped with 1 crusher, 1 set of rolls, 1 Marcy ball mill, 1 Dorr drag classifier, 1 Wilfley pilot table, 1 eight-cell "Mineral Separation" flotation machine for lead, 1 ten-cell "Mineral Separation" flotation machine for zinc (not used), 2 Dorr thickeners, and 1 United disk filter.

LAWRENCE COUNTY [1]

Mine production of gold, silver, copper, and lead in Lawrence County, S. Dak., 1918–1927

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1918	17	1, 781, 661	$6, 565, 151	158, 108	2, 996	11, 536	$6, 724, 818
1919	11	1, 329, 928	4, 863, 013	116, 010	----------	6, 585	4, 993, 293
1920	7	1, 356, 189	4, 676, 470	90, 795	----------	12, 812	4, 776, 461
1921	3	1, 725, 685	6, 603, 318	112, 457	----------	4, 000	6, 715, 955
1922	4	1, 751, 414	6, 515, 969	118, 753	----------	----------	6, 634, 722
1923	4	1, 665, 437	6, 406, 206	95, 844	----------	----------	6, 484, 798
1924	1	1, 670, 300	6, 091, 100	86, 354	----------	----------	6, 148, 957
1925	2	1, 590, 069	5, 988, 570	96, 133	----------	----------	6, 055, 286
1926	2	1, 415, 775	5, 777, 545	82, 186	----------	----------	5, 828, 829
1927	2	1, 371, 583	6, 656, 738	93, 485	----------	----------	6, 709, 744

HOMESTAKE MINE [2]

The total value of the product of the Homestake Mining Co. from 1875 to 1927, inclusive, is $213,036,505.55, and the amount paid in dividends is $52,343,164.29.

Ore milled, receipts, and dividends, Homestake mine, 1918–1927

Year	Ore milled	Receipts for bullion product		Dividends
		Total	Per ton	
	Short tons			
1918	1, 628, 630	$5, 916, 890. 31	$3. 6330	$1, 506, 960
1919	1, 192, 588	4, 346, 115. 79	3. 6443	1, 130, 220
1920	1, 274, 944	4, 410, 193. 73	3. 4591	----------
1921	1, 620, 588	6, 299, 780. 38	3. 8873	502, 320
1922	1, 663, 485	6, 285, 317. 56	3. 7784	879, 060
1923	1, 652, 337	6, 400, 078. 42	3. 8733	1, 506, 960
1924	1, 670, 300	6, 126, 349. 99	3. 6678	1, 758, 120
1925	1, 589, 701	5, 999, 073. 50	3. 7737	1, 758, 120
1926	1, 415, 775	5, 811, 943. 90	4. 1051	1, 758, 120
1927	1, 371, 583	6, 679, 802. 31	4. 8701	1, 758, 120

The annual report [3] of the general manager of the Homestake Mining Co. for the year ended December 31, 1927, says:

> The mining and milling operations of the company have been carried on without interruption throughout the year just passed.

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[1] For information on the geology of this county, see Irving, J. D., Ore Deposits of the Northern Black Hills; Contributions to Economic Geology: U. S. Geol. Survey Bull. 225, 1904, pp. 123–140; Irving, J. D., and Emmons, S. F., Economic Resources of the Northern Black Hills: U. S. Geol. Survey Prof. Paper 26, 1904, pp. 53–212.

[2] For description of geology see Paige, Sidney, The Geology of the Homestake Mine: Econ. Geology, vol. 18, 1923, pp. 205–237; Geology of the Region Around Lead, S. Dak., and Its Bearing on the Homestake Ore Body: U. S. Geol. Survey Bull. 765, 1924, 56 pp.; Central Black Hills, S. Dak.: U. S. Geol. Survey Geol. Atlas, Folio 219, 1925. Hosted, J. O., and Wright, L. B., Geology of the Homestake Ore Bodies and the Lead Area, South Dakota: Eng. and Min. Jour.-Press, vol. 115, May 5, 1923, pp. 793–799; May 12, 1923, pp. 836–843.

[3] Engineering and Mining Journal, extracts from report: vol. 125, No. 15, Apr. 14, 1928, p. 602; vol. 125, No. 16, Apr. 21, 1928, p. 676.

The engineers report as follows: Development drifts driven 14,101 feet; development raises driven 7,098 feet.

The B. & M. No. 2 shaft is completed to the 1,250-foot level.

There are 754,295 tons of ore broken down and remaining in the stopes.

There are 15,037,046 tons of ore blocked out and remaining in the mine.

Two rod mills and two ball mills have been added to the equipment in the South mill.

An electric power generating plant is under construction at the coal mine. One 500-kilowatt steam turbine unit will be installed and space provided for a second unit.

The Homestake mine is opened by three main shafts, the deepest of which is 2,400 feet, and by about 66 miles of adits, drifts, and crosscuts. The mining methods used at the Homestake have been described by Ross and Wayland.[4]

The milling plants operated by the Homestake Mining Co. in 1927 consisted of five amalgamation mills and three cyanidation mills. The amalgamation mills were the Pocahontas and the Terraville ball mills at Terraville and the South mill, the Amicus mill, and the Tungsten mill at Lead; the cyanidation mills were the Sand plant No. 1 at Lead, the Sand plant No. 2 at Blacktail, and the Slime plant at Deadwood. The sands from the Terraville mills go to Sand plant No. 2 and the sands from the Lead mills go to the Sand plant No. 1; the slimes from all five amalgamation mills go to the Slime plant.

The capacity and equipment of these mills are as follows: Pocahontas, 600 tons per day, 160 gravity stamps (900 pounds each), and 2,592 square feet of amalgamation plates; Terraville ball mill, 105 tons per day, 1 ball mill, 1 drag classifier, and 54 square feet of amalgamation plates; South mill, 1,835 tons per day, 120 gravity stamps (1,530 pounds each), 2,860 square feet of amalgamation plates, 8 rod mills, 3 tube mills, 1 ball mill, 10 drag classifiers, and 13 cone classifiers; Amicus mill, 1,240 tons per day, 240 gravity stamps (1,000 pounds each), 3,780 square feet of amalgamation plates, 5 tube mills, 5 drag classifiers, and 12 cone classifiers; Tungsten mill, 18.5 tons per day, 5 gravity stamps (900 pounds each), 36 square feet of amalgamation plates, 1 special ball mill, 6 concentration tables, and 2 driers; Sand plant No. 1, 1,610 tons per day, 44 cone classifiers, 19 leaching tanks, 32 thickening tanks, and 2 precipitation presses; Sand plant No. 2, 400 tons per day, 17 cone classifiers, 4 leaching tanks, 14 thickening tanks, and 1 precipitation press; and Slime plant, 1,680 tons per day, 31 slime filter presses, and 2 precipitation presses. A summarization of the foregoing shows that the amalgamation mills have a total capacity of 3,800 tons per day and the cyanidation mills 3,690 tons per day.

The operation at the Terraville ball mill was discontinued during July, 1927.

One placer in the Rawlings district, near Tinton, Lawrence County, was operated in 1927 and yielded a few ounces of gold.

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[4] Ross, A. J. M., and Wayland, R. G., Mining Methods at the Homestake: Min. and Met., vol. 7, No. 229, January, 1926, p. 21.

PENNINGTON COUNTY

Mine production of gold, silver, and copper in Pennington County, S. Dak., 1918–1927

Year	Mines producing		Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Total value
	Lode	Placer					
			Short tons		*Fine ounces*	*Pounds*	
1918	2	2	602	$155	198	61, 810	$15, 620
1919–20	--------	--------	----------	----------	----------	----------	----------
1921	--------	3	----------	1, 267	6	----------	1, 273
1922	1	1	40	1, 819	7	----------	1, 826
1923	1	--------	2	100	----------	----------	100
1924	3	--------	4, 420	26, 321	194	----------	26, 451
1925	1	--------	10	1, 034	----------	----------	1, 034
1926	1	--------	10	801	----------	----------	801
1927	--------	1	----------	105	----------	----------	105

One placer near Hill City, Pennington County, operated in 1927 and shipped a small amount of gold bullion.

In August, 1927, the Keystone Consolidated Mines Co. (Inc.) began construction of a 100 to 125 ton cyanidation plant at the old Columbia-Holy Terror-Keystone-Bullion-Lucky Boy group, in the Keystone district but across the county line in Pennington County. After unwatering the Columbia shaft development consisted of sinking the shaft from the 200 to the 300 foot level and of driving 150 feet of drifts.

GOLD, SILVER, AND COPPER IN WYOMING

(MINE REPORT)

By CHAS. W. HENDERSON

SUMMARY

Wyoming nonferrous deposits were productive in 1927 for the first time since 1923. An amalgamating mill in the Atlantic City district, Fremont County, produced gold-silver bullion. Development work was renewed in 1927 in several Wyoming districts. The Sunrise iron mine, at Sunrise, continued to supply a large part of the raw iron ore treated at the iron and steel mill at Pueblo, Colo., but it yielded no copper ores, such as were shipped from this property before it was found to be an iron mine and such as were shipped during the high copper prices of 1914 to 1918.

Mine production of gold, silver, and copper in Wyoming, 1918–1927

Year	Ore (short tons)	Gold	Silver		Copper		Total value
			Fine ounces	Commercial value	Pounds	Value	
1918	2,870	$871	965	$965	852,777	$210,636	$212,472
1919	798	84	151	169	139,900	26,021	26,274
1920							
1921	50	62	111	111	10,000	1,290	1,463
1922	24	1,207	57	57	4,296	580	1,844
1923	584	296	254	208	111,280	16,358	16,862
1924–1926							
1927	110	1,200	5	3			1,203

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Centennial district.[1]—Some development work was done at the Cliff property, south of Centennial, on the Middle Fork of Little Laramie River. Its 100-ton amalgamation-flotation mill remained idle. Construction of a concentration mill, near Centennial, to test the rock from the Queen claim on Centennial Mountain was begun.

Douglas Creek district (*Holmes, Foxpark*).—The Rambler copper-platinum-palladium property at Holmes remained idle. The Equity Mining Co. (formerly Moore's Gulch Mining Co.) at Foxpark reports equipment on its gravel deposits as 2 miles of ditches and one giant with a capacity of 500 cubic yards each 24 hours. Development work was done in 1927, but no gold was produced.

Tie Siding district.—A concentration mill was under construction in 1927 at the Copper Hill group, near Tie Siding.

CARBON COUNTY

Encampment district.—Annual assessment work was done at several prospects in the Encampment district.

FREMONT COUNTY

Atlantic City district.—Assessment work was done on unpatented claims in the Atlantic City district in 1927. The Carissa mine, long idle, was kept unwatered; it is opened by a 384-foot shaft and 2,500 feet of drifts and crosscuts. The Hidden Hand 10-stamp Straub circular stamp mill was operated 57 days and yielded gold bullion. The Hidden Hand mine is opened by a 110-foot shaft, two 30-foot shafts, and 640 feet of crosscuts and drifts. No work was done during 1927 at the "1914" or Sullivan property; development work was done at this property during 1924 and 1925 by the Homestake Mining Co., of South Dakota.

LARAMIE COUNTY

Silver Crown district (*Hecla*).—A little work was done in 1927 at the Rambler property. Patent is being applied for on the Monte Christo property.

PLATTE COUNTY

The Colorado Fuel & Iron Co.'s Sunrise iron mine at Sunrise continued to supply iron ore to the company's iron and steel plant at Pueblo, Colo. No copper ore was shipped from this property in 1927.

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[1] For map and description of properties, see Hess, F. L., Platinum Near Centennial, Wyo.; Contributions to Economic Geology: U. S. Geol. Survey Bull. 780, 1926, pp. 127-135.

CHROMITE

By J. W. Furness[1]

INTRODUCTION

The rapid expansion of the consumption of chromium in the United States during the last five years illustrates the rate at which the mineral resources of the world may at any time be called upon to furnish a commodity of whose utilization the civilization of the past had relatively little knowledge. The domestic mining of chromite had its inception in 1827. In that year a commercial deposit of chromite was discovered near Jarrettsville, Harford County, Md. An attempt was made to manufacture paint from this ore, but the effort resulted in financial failure. In 1845 the first successful domestic plant for the utilization of chromite was established near Baltimore. The product was potassium bichromate.

One of the outstanding events of 1927 was the consolidation of control of various patent rights for chromium plating in one corporation known as the General Chromium Corporation. This corporation embraces the interests of the Union Carbide & Carbon Corporation through its subsidiaries, the Electro Metallurgical Co., the Union Carbide & Carbon Research Laboratories (Inc.), and the Vacuum Can Co. The process covered by the patents is the Duro-Chrome.

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[1] The statistics on domestic production were prepared by H. M. Meyer, and the data on imports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

CHROMITE MINING IN THE UNITED STATES

Crude chromite mined and shipped from mines in the United States, 1922–1927, by States

State	Ore containing 45 per cent or more of chromic oxide			Ore containing 35 to 45 per cent of chromic oxide			Total value
	Mined (long tons)	Shipped (long tons)	Value	Mined (long tons)	Shipped (long tons)	Value	
1922							
California	200	163	$3,354	-----	-----	-----	$3,354
Maryland	113	113	3,302	-----	-----	-----	3,302
Montana	-----	-----	-----	10	-----	-----	-----
Oregon	97	79	632	-----	-----	-----	632
	410	355	7,288	10	-----	-----	7,288
1923							
California	69	69	1,415	-----	-----	-----	1,415
Maryland	90	80	1,840	-----	-----	-----	1,840
Montana	-----	-----	-----	22	-----	-----	-----
Oregon	78	78	564	313	-----	-----	564
	237	227	3,819	335	-----	-----	3,819
1924							
California	213	188	940	-----			940
Montana	-----	-----	-----	20	-----	-----	-----
Oregon	-----	-----	-----	-----	[1] 100	[1] $200	200
	213	188	940	20	[1] 100	[1] 200	[1] 1,140
1925							
California	83	83	1,650	-----	-----	-----	1,650
Maryland	25	25	455	-----	-----	-----	455
Oregon	-----	-----	-----	47	-----	-----	-----
Washington	2	-----	-----	-----	-----	-----	-----
	110	108	2,105	47	-----	-----	2,105
1926							
California	127	47	957	-----	44	22	979
Maryland	67	50	1,100	-----	-----	-----	1,100
	194	97	2,057	-----	44	22	2,079
1927							
California	50	[2] 201	[2] 5,063	-----	-----	-----	[2] 5,063

[1] Ore from Oregon in 1924 contained less than 35 per cent Cr_2O_3.

[2] According to the quarterly report of the division of mines and mining, department of natural resources, California, April, 1928, p. 161, which states that 225 short tons (201 long tons) of chromite were sold in 1927. No shipments for 1927 were reported by the producers to the Bureau of Mines.

Some chromite was reported mined in Placer and San Luis Obispo Counties, and some was shipped from Calaveras County, Calif. The only other operations on chromite deposits in the United States in 1927 were limited to development work in Sweet Grass and Stillwater Counties, Mont. The mineralized area of the Montana locality has been described in part by L. G. Westgate in United States Geological Survey Bulletin 725, pages 67 to 84.

IMPORTS

Crude chromite imported into the United States, 1922–1927, in long tons

[General imports]

Country	1922	1923	1924	1925	1926	1927	
						Quantity	Value
Africa:							
British—							
East				678	1,000		
South	41,002	52,153	21,642	18,463	17,794	[1] 6,935	[1] $42,835
Portuguese—							
East	7,100	15,591	37,152	70,718	105,022	[2] 128,851	[2] 775,142
Other	4,000		26,287	6,805	7,724	21,263	147,034
Australia	4,000						
Brazil					1,840	729	16,390
Canada	801	3,401					
Cuba	1	10,420	8,145	29,830	36,020	16,983	149,434
England	1,900	(3)		[4] 20			
Greece	8,600	10,550	13,390	12,533	21,065	22,527	243,737
Guatemala					53		
India (British)	12,677	29,238	7,335	8,360	13,800	13,572	197,471
Japan				300			
Oceania (French)	7,500	7,410	4,392	2,032	11,146	11,500	176,555
Turkey in Asia	[5] 2,500						
	90,081	128,763	118,343	149,739	215,464	222,360	1,748,598

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[1] Recorded as Union of South Africa for 1927.
[2] Recorded as Mozambique for 1927.
[3] Quantity not recorded.
[4] Recorded as United Kingdom for 1925.
[5] Recorded by Bureau of Foreign and Domestic Commerce as Greece in Asia.

The total imports of chromite into the United States in 1927 amounted to 222,360 long tons, or approximately 56 per cent of the world's production in that year. The following table shows the imports of chromite during the period January 1 to August 1, 1927, and the nationality of bottoms delivering this chromite to the United States.

Chromite shipped into the United States and nationality of bottoms in which shipped, January 1 to August 1, 1927, in long tons[1]

Country	Flag	Long tons
Brazil	Swedish	1,825
Cuba	British	3,627
	Norwegian	6,462
	United States Shipping Board	2,891
Greece	British	2,470
	Japanese	800
India	British	2,131
	United States Shipping Board	1,010
New Caledonia	French	3,000
	United States Shipping Board	3,000
Rhodesia	British	108,985
	United States Shipping Board	17,265
Summary	British	117,213
	French	3,000
	Japanese	800
	Norwegian	6,462
	Swedish	1,825
	United States Shipping Board	24,166
		153,466

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[1] Division of statistics, Bureau of Research, U. S. Shipping Board, Sp. Rept. D. S. No. 855, Feb. 9, 1928.

Ferrochrome or ferrochromium, chrome or chromium metal, and chromium vanadium imported for consumption in the United States, 1923–1927, in long tons

	1923	1924	1925	1926	1927
Ferrochrome or ferrochromium:					
Containing 3 per cent or more of carbon (chromium content)	1, 116	30	69	15	1
Containing less than 3 per cent of carbon, gross weight	295	436	588	495	143
Chrome or chromium metal	13	2	3	1	10
Chromium vanadium	57	------	32	20	------

Chromium compounds imported for consumption in the United States, 1919–1927

Year	Chromic acid			Chromate and bichromate of potash			Chromate and bichromate of soda			Chromium chloride and sulphate		
	Pounds	Value		Pounds	Value		Pounds	Value		Pounds	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1919	--------	--------	--------	15, 450	$4, 271	$0. 28	--------	--------	--------	(1)	(1)	(1)
1920	1, 100	$90	$0. 08	4, 414	2, 690	. 61	--------	--------	--------	(1)	(1)	(1)
1921	1, 969	674	. 34	73, 011	6, 772	. 09	64, 236	$5, 308	$0. 08	(1)	(1)	(1)
1922	4, 663	1, 289	. 28	8, 584	1, 676	. 20	22, 731	1, 540	. 07	(1)	(1)	(1)
1923	4, 632	2, 026	. 44	5, 563	1, 033	. 19	245	73	. 30	2, 771	$654	$0. 24
1924	32, 493	2, 484	. 08	10, 486	1, 924	. 18	--------	--------	--------	9, 095	1, 340	. 15
1925	5, 564	2, 216	. 40	4, 379	778	. 18	221	46	. 21	3, 520	941	. 27
1926	7, 220	2, 892	. 40	8, 177	1, 449	. 18	220	44	. 20	1, 310	693	. 53
1927	15, 620	9, 755	. 62	5, 007	906	. 18	330	67	. 20	40, 650	2, 419	. 06

[1] Not separately classified prior to change in tariff, Sept. 22, 1922. None recorded Sept. 22 to Dec. 31, 1922.

Domestic sales, imports, and supply of chromite in the United States, 1919–1927

Year	Sales from domestic mines			Imports (general)			Apparent available supply		
	Long tons	Value		Long tons	Value		Long tons	Value	
		Total	Average		Total	Average		Total	Average
1919	5, 079	$129, 302	$25. 46	61, 404	$1, 381, 497	$22. 50	66, 483	$1, 510, 799	$22. 72
1920	2, 502	44, 857	17. 93	150, 275	1, 921, 824	12. 79	152, 777	1, 966, 681	12. 87
1921	282	2, 900	10. 28	81, 836	654, 602	8. 00	82, 118	657, 502	8. 01
1922	355	7, 288	20. 53	90, 081	741, 186	8. 23	90, 436	748, 474	8. 28
1923	227	3, 819	16. 82	128, 763	1, 123, 120	8. 72	128, 990	1, 126, 939	8. 74
1924	288	1, 140	3. 96	118, 343	1, 095, 603	9. 26	118, 631	1, 096, 743	9. 24
1925	108	2, 105	19. 49	149, 739	1, 207, 420	8. 06	149, 847	1, 209, 525	8. 07
1926	141	2, 079	14. 74	215, 464	1, 704, 947	7. 91	215, 605	1, 707, 026	7. 92
1927	[1] 201	[1] 5, 063	25. 19	222, 360	1, 748, 598	7. 86	222, 561	1, 753, 661	7. 88

[1] According to the division of mines and mining, department of natural resources, California.

PRICES

Possibly due, in part, to the large latent resources of chromite, such as those of Anatolia, Russia, and South Africa, the increased world's demand of 1927 had but slight effect upon the world's price during the year as compared with the average price for the year 1926. The New York prices of chromite on the basis of 45 to 50 per cent Cr_2O_3, according to the Engineering and Mining Journal, were as follows from 1914 to 1927:

Quoted prices per long ton of chromite at New York, 1914–1927

Year	Price	Year	Price
1914	$14.75	1921	$10.28
1915	11.20	1922	22.53
1916	15.44	1923	19.00
1917	24.00	1924	21.35
1918	44.99	1925	21.92
1919	17.25	1926	22.46
1920	17.93	1927	22.88

USES

The world's production of chromite finds its way into three major channels, namely, metallurgical, refractory, and chemical. It has been estimated that the consumption in the United States in 1927 might be divided as follows:[2] Ferrochrome (metallurgical), 46 per cent; refractory, 41 per cent; and chemical, 13 per cent.

METALLURGICAL

According to an article entitled "Alloy Steels," by G. L. Norris, published in the Canadian Mining Journal, January 15, 1916, page 44, three alloys of chromium-nickel steel were at that time in general use. These steels contained but little carbon and differed in their percentage of chromium and nickel content, as the following table shows.

	Chromium	Nickel	Carbon
1	1.5	3.5	0.25–0.45
2	1.0	2.0	.1
3	.5	1.5	.1

The chromium alloy, indicated as "1," came into general use in 1895 for armor plate and armor-piercing projectiles. The rapid increase in consumption of the alloys "2" and "3" has been due in the main to the expanding of the automobile industry. Chromium steels containing approximately 1 per cent of chromium and 1 per cent of carbon are largely utilized in the manufacture of such articles as shoes and dies, for use in stamp mills, and burglar-proof safes. The expanding market for stainless steel and iron is playing its part in the ever-increasing consumption of chromium in the manufacture of steel. In the manufacture of chromium steels and irons, the chromium is added in the form of ferrochrome, which is made from chromite in the electric furnace. In this process the bath tends to take up much carbon, and as carbon is considered undesirable the quality and price are in inverse proportion to the carbon content. In the making of ferrochrome by the methods now in use there is a considerable loss of chromium. It seems reasonable to suppose that research work will before long evolve a method for the utilization of the chromium direct from the chrome ore. Such a process would eliminate the seemingly wasteful step of manufacturing ferrochrome. Chromium is used in steel because it imparts to the alloy the physical qualities of hardness and toughness, a rare combination. Chromium also affects the magnetic properties and very materially increases the resistance of steel to corrosion. The metallurgist requires for his purposes chrome ore of a high degree of purity. The usableness of the ore under present practice depends largely on the ratio of chromic oxide to the iron content. Ferrochrome to be acceptable to the trade must contain not less than 60 per cent of chromium.

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[2] Sampson, Edward, Chromite: Eng. and Min. Jour., vol. 125, No. 3, Jan. 21, 1928, p. 104.

The metallurgical difficulties encountered in the manufacture of rustless iron (carbon less than 0.12 per cent) are gradually being solved, and it seems that in the near future an alloy will be made on a commercial scale which will withstand corrosion indefinitely. In 1926 five domestic companies were engaged in the sale of various brands of rustless iron and rustless steel. Now three processes are utilized:[3] (1) The introduction of chromium by means of a very low-carbon ferrochromium; (2) the direct process, in which an electric furnace is used for the reduction of chromite; (3) the gaseous reduction of a mixture of iron ore and chromite to metallic form (for most of the iron and part of the chromium), with subsequent melting to produce the alloy. The present cost seems too high and is restricting the sales. It is reported that in Germany a process has been developed at a production cost of 5 cents a pound. The corresponding figure in the United States is approximately five times this amount.

An estimate by E. F. Burchard, of the United States Geological Survey, of the reserves of iron ore in the Lake Superior and Birmingham districts indicates a reserve of grades now used sufficient, at the present rate of consumption, for 30 years, and makes evident the need of the conservation of this most common metal. Any alloy that will materially increase the life of steel should find a ready market, as it will materially assist in postponing the day when the steel industry will have to be practically revolutionized in order to utilize the low-grade ores available, such as the ferruginous schists of the Lake Superior district. Otherwise, domestic manufacturers will have to depend upon foreign sources to supply their needs and to maintain a basic industry.

REFRACTORY

The potential uses of chromium seem to open a field so useful to humanity that attention is called to the relatively large consumption of chromite as a refractory. In this use the service rendered is of but short duration and might be termed "ephemeral." As chromium may be used for the preservation of many metals, it becomes evident that any of the uses which rapidly dissipate chromium should be eliminated. The desired end can be accomplished only by research work for the purpose of finding a substitute for the dissipating uses.

A refractory suitable to the requirements must have, among other things, the following physical and chemical properties: (1) Resistance to chemical reaction with fused metals, slags, vapors, etc.; (2) resistance to deformation caused by a wide range of temperatures; (3) strength to withstand loads, blows, shocks, etc., in wide range of temperatures; (4) thermal conductivity; (5) durability (time of service); (6) uniformity; (7) resistance to erosion, spalling, etc.; (8) capability of conforming to accurate measure when molded.

In 1923 in the United States approximately three magnesia bricks were manufactured to one of chromite. In 1927 the ratio has been reported to be approximately 1 to 1. The usableness of chromite as a refractory depends in part upon the physical structure. The most important requirement, however, is the ratio of the chromium and alumina content to the iron and silica tenor. The following table gives the general physical characteristics of the chromite imported from the major sources from which the United States draws its supply. The table also shows the reported average analysis of the grade of ore being marketed.

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[3] Iron Age, June 9, 1927, p. 1687.

Physical structure and chemical analysis of chromite from major sources supplying the needs of the United States

Country	Physical structure (nature)	Chemical analysis	Per cent	
			Low grade	*High grade*
Cuba	Amorphous and sandy, fine; some lump with tendency to soften and disintegrate.	Chromic oxide	34.14	43.97
		Magnesia	15.14	18.95
		Alumina	30.18	10.78
		Ferric oxide	16.07	13.97
		Silica	3.08	8.92
		Ignition loss	1.40	3.34
			Average grade	
Greece	Crystalline, good structure	Chromic oxide	38.83	
		Magnesia	16.33	
		Alumina	21.18	
		Ferric oxide	17.01	
		Silica	4.70	
		Ignition loss	2.44	
			Medium grade	
India	Mostly crystalline but not so closely knit structurally as desired for refractory purposes.	Chromic oxide	42.38	
		Magnesia	13.78	
		Alumina	14.34	
		Ferric oxide	23.96	
		Silica	6.03	
		Ignition loss	2.13	
			High grade	
New Caledonia	Crystalline dense, easily reduced to sand: one of the sources of high-grade chemical ore due to high-chromium low-silica content.	Chromic oxide	55.02	
		Magnesia	8.00	
		Alumina	11.10	
		Ferric oxide	12.77	
		Silica	3.00	
			Medium grade	*High grade*
Rhodesia	Crystalline dense, also sandy, and friable; refractory grade from this source known as Imperial is a selected grade and must withstand the severest uses to which chromite is subject as a refractory; several grades are produced.	Chromic oxide	42.38	49.43
		Magnesia	8.88	13.95
		Alumina	15.16	13.60
		Ferric oxide	29.67	19.47
		Silica	4.12	5.59
		Ignition loss	.92	1.67
			Average grade	
Turkey	Semicrystalline and sandy; fair percentage of lump when mined; has a tendency to disintegrate when exposed to weathering.	Chromic oxide	44.55	
		Magnesia	19.10	
		Alumina	15.20	
		Ferric oxide	15.25	
		Silica	5.40	
		Ignition loss	.30	

Some of the trade brands of chromite used in refractories are: Imperial, 45 to 50 per cent Cr_2O_3; Plymouth, 38 to 45 per cent Cr_2O_3; Grecian High Grade, 36 to 42 per cent Cr_2O_3, and 18 to 25 per cent Al_2O_3; and Larco, 32 to 37 per cent Cr_2O_3 and 27 to 33 per cent Al_2O_3. In the lining of open-hearth furnaces crude lump ore in the form of a dry wall with the interstices filled with fine ore is sometimes used.

Crude fine ore is being manufactured into a chromium cement, which is largely used when a monolithic form is required. The demand of the paper-pulp mills for chromite brick has lately developed a seemingly expanding market. These brick fulfill a need in the lining of the kilns used for the drying of pulp in the sulphide process, as they resist corrosion caused by the liberated gases in the kiln.

CHEMICAL

The chemical trade demands at present chromite of high purity. The ore must have a high tenor of chromic oxide. These ores are utilized largely in the manufacture of potassium and sodium bichromate, which form the base from which the chromic acid of commerce is manufactured. The chromates are treated with concentrated sulphuric acid, which liberates crystalline chromium trioxide.

Among the uses requiring chromic acid are the manufacture of electric batteries, photography, etching of copper, bleaching, etc. By far the larger part of the consumption, however, is in electroplating and in the tanning industry. Sodium or potassium bichromate is used in the manufacture of pigments; chrome yellow is produced by treating either the sodium or potassium bichromate with acetate of lead or some other soluble lead salt. Various shades of yellow are produced by varying the chemical proportion of these elements. "American vermilion," used largely as a substitute for artificial or manufactured cinnabar, is a basic lead chromate, made by dissolving chrome yellow in caustic soda. Chrome green is manufactured by mixing chrome yellow with Prussian blue and is used in the manufacture of lithographic inks. During the past three years the consumption of chromic acid has been greatly increased by the chromium-plating industry.

The adaptation to commercial practice of the research work on chromite has resulted in part in such uses as the chrome plating of printing plates. The United States Bureau of Engraving and Printing, in collaboration with the United States Bureau of Standards, devised a method for the chrome plating of the plates used in the printing of the United States bank notes.[4]

During 1927 the cost of producing bichromate of soda was relatively the same as that of 1926, in that the price of chromite (ore) was relatively constant, and the lower price of soda ash was counterbalanced by the somewhat higher price of sulphuric acid. The production of sodium bichromate in 1927 is estimated at 26,000 tons. Potassium bichromate has been largely supplanted by sodium bichromate, as the larger part of the consuming industry gives preference to the soda product.[5]

The following table is taken from the Census of Manufactures, 1925:

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[4] U. S. Bureau of Standards, Application of Chromium Plating to Printing Plates, Cir. Letter 177, Sept. 8, 1925. Superseded by Technol. Paper 346, Electrodeposition of Chromium for Chromic Acid Baths, by H. E. Haring and W. P. Barrows, 1927, 4 pp.

[5] Chemical and Metallurgical Engineering, Bichromate of Soda Held Steady Course: Vol. 35, No. 1, January, 1928, p. 58.

Sodium chromate and bichromate produced in the United States, 1919, 1921, 1923, and 1925

	1919	1921	1923	1925
Number of establishments	5	9	5	5
Short tons	22, 992	18, 169	26, 879	27, 820
Value	$5, 337, 389	$3, 823, 465	$3, 994, 566	$3, 526, 568

WORLD'S PRODUCTION

Production of crude chromite, 1923–1927, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923	1924	1925	1926	1927
Australia	1, 211	785	978	607	----------
Brazil [1]	----------	----------	----------	1, 500	1, 820
Canada	3, 228	----------	----------	----------	----------
Cuba	[2] 10, 587	[3] 19, 881	[2] 30, 309	[2] 36, 598	[2] 17, 256
Cyprus [1]	----------	2, 856	2, 021	524	711
Great Britain	555	1, 060	455	----------	384
Greece	14, 828	14, 651	8, 079	20, 049	15, 051
Guatemala [2]	----------	----------	----------	54	----------
India, British	55, 113	46, 192	38, 053	33, 918	58, 125
Indo-China	----------	20	----------	----------	----------
Japan	4, 526	5, 362	5, 823	7, 052	([4])
New Caledonia [1]	23, 220	23, 021	34, 732	34, 267	42, 885
Norway [1]	35	177	440	17	----------
Rhodesia, Southern	87, 702	156, 692	123, 220	164, 376	197, 782
Rumania	60	----------	----------	----------	----------
Russia [5]	892	11, 894	30, 111	30, 362	18, 060
Turkey (Asia Minor)	([4])	([4])	6, 809	4, 418	16, 609
Union of South Africa	----------	4, 572	13, 756	12, 042	16, 959
United States (shipments)	231	293	110	143	204
Yugoslavia	([4])	300	12, 160	15, 983	8, 757
	202, 188	287, 756	307, 056	361, 910	([4])

[1] Exports.
[2] Imports into the United States.
[3] Production of the Caledonia mine.
[4] Data not available.
[5] Data for year ended Sept. 30.

CANADA

During the war period, 1914 to 1918, the production of chromite in Canada was largely confined to the Provinces of Quebec and British Columbia. By far the larger part of the production heretofore has come from the Province of Quebec, in the vicinity of Coleraine, Thetford, and Black Lake. For some years a custom mill, treating crude ore containing approximately 12 per cent of chromic oxide and producing a concentrate containing more than 50 per cent of Cr_2O_3, has been in operation at Black Lake. For a time during the war this product was shipped to the United Chemical Co. of America. The largest developed mine in this locality is the Black Lake Asbestos & Chrome Co. The property is on lots 27 and 28, range B, of Coleraine.

The ore is said to occur in irregular pockets and masses and disseminated in serpentine.[6]

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[6] Rumbold, W. G., Imperial Institute Monographs on Mineral Resources, with Special Reference to the British Empire: Chromium Ore, London, 1921, p. 26.

CUBA

During 1927 there were two mines producing chromite in Cuba. The properties from which the ore was shipped are northeast of Camaguey on the Nuevitas-Camaguey branch of the Cuba Railroad; the ore is shipped to the United States from the ports of Nuevitas and Puerto Tarafa. The shipments of chromite from Cuba were 29,830 long tons in 1925, 36,020 tons in 1926, and 16,983 tons in 1927.

The ore shipped is of low grade and is said to have been used in the manufacture of refractory bricks.

GREECE

The Grecian ores usually average 40 per cent or less of Cr_2O_3. Three-fourths of the total production of so-called high-grade chromite is produced by the Société Union Minière, Athens, and Apostolidès Bros., Volos.

Chromite produced, shipped, and in stock in Greece, 1925–26, in metric tons

Year	Production	Shipments	Stocks (Dec. 31)
1925	8, 079	9, 363	6, 926
1926	20, 049	20, 142	6, 833

INDIA

The production of chromite in India in 1927 amounted to 57,207 long tons, compared with 33,382 tons in 1926.

The following table shows exports of chromite from Karachi, India, by countries of destination, in 1926 and 1927:[7]

Chromite exported from Karachi, India, 1926–27, by destinations, in long tons

Destination	1926	1927
Belgium	5, 670	6, 610
France	2, 400	2, 900
Great Britain	1, 875	1, 125
Italy	1, 850	700
Netherlands	100	3, 900
Sweden	4, 800	----------
United States of America	500	----------
	17, 195	15, 235
Decrease, 1927	----------	1, 960

NEW CALEDONIA

The shipments of chrome ore from New Caledonia in 1927 amounted to 42,885 metric tons, as compared with 34,267 tons in 1926.

RHODESIA AND UNION OF SOUTH AFRICA

Rhodesia is the largest source of high-grade ore and has the largest resources now developed. Most of the ore termed in the trade "Imperial Chrome" comes from this source. There are two classes of deposits. One is massive and occurs in schists. The developed deposits of this character are near Selukwe; the ores are utilized largely in the steel trade. The following is said to be a typical analysis of the Selukwe ores,[8] as made by Wallace & Clarke, of Glasgow: Cr_2O_3, 51.10 per cent; FeO, 11.40 per cent; Fe_2O_3, 1.40 per cent; MnO, 0.50 per cent; Al_2O_3, 15.20 per cent; MgO, 12.70 per cent; CaO, 0.90 per cent; P_2O_5, 0.50 per cent; S, trace; SiO_2, 4.80 per cent; H_2O, etc., 1.97 per cent. The other class of deposit occurs in what is known as the Great Dyke. The ore is in thin seams, is rich in chromium, and is utilized largely in the chemical trade.

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[7] Richardson, E. Verne, American consulate, Karachi, India, "Chrome Ore Export—Karachi, India, January-December, 1927": Cons. Rept. 272022, Jan. 28, 1928.

The Transvaal chromite is hard and massive, differing from the Rhodesian ore, which is more or less friable. The ore contains about 42 per cent of chromic oxide, with about 3 per cent of silica, and is guaranteed to contain not more than 4 per cent of silica. The iron oxide content ranges between 20 and 25 per cent and is guaranteed not to exceed 28 per cent. A large part of the Transvaal chromite carries metallic platinoids in minute quantities.

RUSSIA

Before the war Russia produced a considerable tonnage of chromite from the Serpentine area of the Ural Mountains. In the February 3, 1928, issue of Economic Life, Moscow (official), page 3, the following statement appears:

> It has been decided to build a special chromium concentrating plant in the Ural. At this plant the ore will be concentrated to a minimum content of 54 per cent of chromium dioxide, guaranteeing the sale of this article abroad.

Chromite produced in Russia in years ended September 30, 1925 and 1926, by regions, in metric tons [1]

Region	1925	1926
Ural Province	22,117	26,622
Orenburg Government	87	
Bashkirian Republic	4,991	3,740
Kazakstan Republic	2,916	
	30,111	30,362

[1] Geological Committee, Russia, Annual Report on the Mineral Resources of the U. S. S. R., 1925-6, p. 777. Leningrad, 1927.

TURKEY

It has been announced that a French financial group, comprising the Société Minerais et Métaux, the Société de Peñarroya, the Comptoir Lyon Alemand, and the Société de Balia Karaidin, has secured from the Turkish Government a concession to work the Makri chrome ore deposits.[9] A concentrating plant is to be erected and transportation facilities are to be modernized. The largest deposits of chromite found in Asia Minor are in the Province of Brusa. The deposits of the Makri district, while not so large as those of Brusa, are known to contain large reserves of ore. The Makri mines are mainly in the Vilayets of Aidin, Denizli, Burdur, and Mentesheh to the south of Smyrna. Formerly the ore produced from these districts was shipped from the Port of Smyrna. The developed mines are south of Makri. The lenses are said to be from 3 to 7 feet in thickness, and the tenor of the ore varies from 40 to 52 per cent Cr_2O_3.[10]

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[8] Correspondence with G. K. Donald, American consulate, Johannesburg, South Africa, May 3, 1927.

[9] Mining Journal, London, "French chrome ore concession in Turkey": Dec. 31, 1927, p. 1106.

The production of chromite in Turkey in 1926 and 1927 is officially reported as follows: 1926, 4,418 metric tons; 1927, 16,609 tons.

YUGOSLAVIA

Deposits of chromite occur in Serbia at Ridjevstica near the foot of Mount Kopacnik. The ore is said to occur as granular chromite in the proximity of mica schists.[11] In Bosnia the chromite deposits occur in a belt of serpentine extending from Banjaluka to the Serbian frontier. The largest mineralized area is approximately 114 square kilometers. The most important projects in this locality are in the Dubostica Valley.[12] The mining of chromite in Yugoslavia is an old industry. Under the Turkish régime mining was started about 1880. The ore, said to contain from 40 to 50 per cent of Cr_2O_3, was transported by mule and cart to Saloniki for exportation.

In a consular report dated January 28, 1926, Herbert S. Bursley describes the chromite deposits of Yugoslavia. On page 9, under "Summary," this report states:

> The best known sources of supply are already in the control of foreign groups, principally German.
>
> The "Orashje," "Gorantsi," "Radushi," "Ostrovatz," and "Arnichka" deposits are controlled by Allatini Brothers; the "Sholdan" by a Mr. Jacques Hiel, who is said to be in Paris; "Rabrove" by Hoppe & Company, "Ljuboten" by a group known as Hemicos; and "Valandovo" by the German "Meteor" group.
>
> The new limited liability company of Ljubotan is controlled by German capital. The Yugoslav Government is said to have a 33 per cent interest in the enterprise. No concession has yet been given, but a contract, renewable annually, has been made between the exploiters and the Government. Application has been made for a 50-year concession, which will probably be granted.

WORLD TRADE IN CHROMITE

The table following illustrates the many sources from which the world's principal consumers of chromite draw their supply:

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[10] Corrigan, John, jr., U. S. Consul, Smyrna, Turkey, Developments in Chrome Mining in the Smyrna District: Cons. Rept. 263,996 Oct. 15,1927.

[11] Mineral Resources, 1918, pt. 1, pp. 686–687.

[12] Rumbold, W. G., Imperial Institute Monographs on Mineral Resources, with Special Reference to the British Empire; Chromium Ore: London, 1921, p. 40.

Chromite imported into Germany, Great Britain, and the United States, 1925–1927, by countries from which imported, in long tons [1]

Importing country	Country from which imported	1925	1926	1927	Source of information
Germany	Australia	1,573	4,563	8,742	Der Auswärtige Handel Deutschlands.
	British India	7,553	4,947	1,735	
	British South Africa	5,615	4,800	19,562	
	Spain	506	2,755	1,131	
	Turkey	--------	1,279	--------	
	Yugoslavia	1,272	2,036	2,318	
	Other countries	8,951	737	3,093	
		25,470	21,117	36,581	
Great Britain	Foreign countries:				Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions.
	Belgium	18	61	(2)	
	French possessions in Pacific	4,958	5	(2)	
	Portuguese East Africa	4,368	3,187	(2)	
	Other foreign countries	2,219	71	(2)	
		11,563	3,324	(2)	
	British countries:				
	British India	8,307	3,094	(2)	
	Rhodesia	910	520	(2)	
	Other British countries	260	125	(2)	
		9,477	3,739	(2)	
		21,040	7,063	(2)	
United States	Africa	96,664	131,540	157,049	Foreign Commerce and Navigation of the United States.
	Brazil	--------	1,840	729	
	Cuba	29,830	36,020	16,983	
	French Oceania	2,032	11,146	11,500	
	Greece	12,533	21,065	22,527	
	Guatemala	--------	53	--------	
	India	8,360	13,800	13,572	
	Japan	300	--------	--------	
	United Kingdom	20	--------	--------	
		149,739	215,464	222,360	

[1] Imports into other principal consuming countries not available.
[2] Imports by countries not available.

CADMIUM

By Paul M. Tyler[1]

GENERAL STATEMENT

More than a million pounds of metallic cadmium was produced in the United States in 1927, and the sales of the metal and its compounds constituted a total business of some $800,000. These figures, though small as compared with those for the major metals, are significant for the reason that they represent developments that have taken place principally within the last three or four years. Previous to 1906 no cadmium was produced in this country; the world output, supplied wholly by Germany, amounted to only about 50,000 pounds annually. Even during the World War the production of the entire world never exceeded 400,000 pounds a year, which is roughly the capacity of one new plant completed toward the close of 1927. This Canadian plant and a similar installation at the electrolytic zinc works at Risdon, Tasmania, together with minor developments in European countries, represent a productive capacity abroad fully equal to that of the United States. Despite these signs of expanding production, the trend of world prices in early 1928 was strongly upward.

Metallurgically cadmium resembles zinc and is recovered mainly as a by-product of zinc production. Physically it more closely resembles tin. Although cadmium was actually used more extensively during the World War in telephone and telegraph wires, it first gained wide publicity as a substitute for tin in solders; and recently one of its greatest uses, like that of tin, has been for rustproofing steel. It even emits a crackling sound quite like the peculiar " cry " of tin when bent. This cry serves as a rough test of purity, as it can not be obtained from metal that is more than slightly impure.

Cadmium comes on the market principally in sticks about $\frac{5}{16}$ inch in diameter and 12 inches in length, packed in strong wooden boxes containing 100 pounds. It is also obtainable in the form of heavy wire (No. 13) for use in metal-spraying devices. Formerly it was marketed in ingots or blocks of specified sizes, but now these are rarely seen. One domestic company produces from time to time an alloy containing 90 per cent of cadmium and 10 per cent of zinc; but the usual product, being electrolytically or chemically precipitated, is almost pure. Copper, lead, zinc, and iron may be present in small amounts, and a little thallium has been found in certain brands, but the total impurities almost never exceed 0.25 per cent and are frequently under 0.05 per cent.

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[1] Unless otherwise stated, the statistics in this report were prepared by H. M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

PROPERTIES

Cadmium is a soft heavy metal, ductile enough to be beaten out into thin foil or drawn into wire. The specific gravity is 8.6, making it about as heavy as nickel. Although it is a trifle harder than tin, it will mark paper and hence is much softer than zinc. In hardness and tenacity it is intermediate between tin and gold. The boiling point (778° C.)[2] is lower than that of zinc. The vapor is deep yellow, and the metal burns readily when heated in the air, evolving fumes of brown oxide.

Among the properties that make cadmium valuable commercially are its resistance to oxidation and its unusually low melting point. Cadmium melts at a relatively low temperature (320° C.) and has a further property of greatly increasing the fusibility of other metals with which it may be alloyed without making them brittle. Added to copper or silver, it acts as a hardening and toughening agent. The color of cadmium, white with a slightly bluish tinge, is not unattractive. In dry air the metal will stay bright almost indefinitely, and although it takes on a superficial film of oxide in moist air it is suitable, nevertheless, for rustproofing iron and steel.

Cadmium salts are all poisonous, a fact that has retarded the use of cadmium in solders and has restricted somewhat the field for cadmium plating, as the metal can not be employed in any way for food containers without endangering the health of consumers. Despite its resistance to atmospheric agencies, cadmium is attacked even more than zinc by acetic, tartaric, and probably other weak acids present in foods. A dose of 0.03 gram of a cadmium salt is fatal to animals,[3] and very small quantities are highly toxic to human beings.

USES

Low-melting alloys.—Cadmium is a constituent of nearly all of the well-known alloys employed in fusible plugs for automatic sprinklers, steam boilers, and fire alarms, and for safety fuses in electric circuits. In addition to cadmium (1 to 15 per cent), these mixtures usually contain lead, tin, and bismuth. By varying the relative proportions of the different constituents, alloys with a wide range of melting points can be produced. Lipowitz's metal, a white metal with a luster like that of polished silver, which melts at 60° C., is used for making casts of small animals and insects and forms an especially good solder for Britannia metal. A similar alloy is used for making casts of parts of the human body. Wood's metal, which is even better known, melts at a slightly higher temperature (71° C.). There are quite a number of these multiple alloys that melt at temperatures below the boiling point of water; several of them are moderately strong and can be bent or worked in a lathe. An antimony-lead alloy containing bismuth and cadmium has been invented for bonding glass.[4]

Cadmium formerly entered largely into dental alloys. A common dental amalgam consisted of 26 per cent of cadmium and 74 per cent of mercury—tin and bismuth often being added to the mixture—but this amalgam discolors the dentine more than other mixtures subsequently developed and has been largely discontinued. Cliché metal for stereotype plates may be made with about 22.5 per cent of cadmium, 50 per cent of lead, and 27.5 per cent of tin, a mixture superior to the corresponding cliché metal containing bismuth, as it gives a greater number of impressions.

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[2] Smithsonian physical tables.

[3] Gronover, A., and Wohnlich, E. (Cadmium as a Plating Metal for Utensils): Ztschr. Unters. u. Lebensm., vol. 53, 1927, pp. 392-396; Chem. and Ind., Brit. Chem. Abs., vol. 46, Sept. 2, 1927, p. 657.

[4] Geppert, J., U. S. Patent 1584922, May 18, 1926.

Hard alloys.—An important use of the metal is in copper telephone and trolley wires. In proportions of 0.5 to 1.2 per cent cadmium raises the annealing temperature and adds materially to the strength and wearing qualities of copper without greatly reducing the conductivity, as practically all other hardening agents do. Some quantities of cadmium are used to improve the properties of both plated and sterling silverware.[5] In the jewelry trade cadmium is employed for producing green gold.

Cadmium plating.—A new use, which because of its connection with the automobile industry has become of great importance, is in rustproofing steel, particularly nuts, bolts, sundry small parts for automobiles, and various light hardware, including locks, refrigerator trimmings, and certain wire products. The udylite process, covered by United States Patents 1383174, 1383175, and 1383176 (among others), embodies electroplating with cadmium and subsequent heating in an oven for several hours at 150° to 200° C. The plating solution is an alkaline cyanide saturated with cadmium. Metallic cadmium anodes are mentioned in the patents, but graphite or steel is ordinarily employed. Both metallic cadmium and cadmium oxide are used in preparing the bath. As a protective coating the deposit of cadmium is claimed to be superior to zinc in that it has a more even surface and, having less porosity, affords better protection with a thinner deposit. After a salt-spray test lasting 1,860 hours a cadmium-plated steel sheet exhibited no signs of rusting, whereas rust developed in a much shorter time on hot-galvanized, sherardized, and electrolytic zinc-plated sheets, on a nickel-plated sheet, and even on a sheet plated with nickel over cadmium.[6] The cadmium coat forms an alloy with the steel, and it is remarkably adherent even when applied to aluminum and light alloys. Because of its thinness, its extraordinary adhesiveness, and its softness cadmium does not peel or crack off like nickel or zinc when damaged by the jaws of a pipe wrench or pliers. Cadmium-plated articles can be given various finishes, ranging from bright to soft satin and French gray. Cadmium plating alone does not produce a satisfactory silverlike finish, because its brilliance is soon lost, principally because it is too soft to withstand abrasion, but it may be used as a base coat for subsequent plating with nickel, copper, or brass.[7]

In 1921 the udylite process was installed in 18 plants, and by the end of 1922 it had been adopted by more than 50 plants. The Udylite Process Co. of Kokomo was incorporated under the laws of Indiana in 1922, deriving its name from the inventor of the process, Marvin J. Udy. The original company, together with all its patents and patent applications, was purchased outright by the Union Carbide & Carbon Corporation in 1927.[8]

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[5] Tests at the Bureau of Standards indicated that no silver alloys were strictly "nontarnishing," but alloys of silver with cadmium or zinc were the most tarnish-resisting of the binary alloys tested and were quite workable, though weak. Jordan, L., Grenell, L. H., and Herschman, H. K., Tarnish-Resisting Silver Alloys: U. S. Bureau of Standards Technol. Paper 348, 1927, 50 pp.

[6] Humphries, C. H., Cadmium Plating Resists Rust: Iron Age, vol. 120, 1927, pp. 401–402.

[7] The merits of cadmium electroplating are discussed in the Monthly Review of the American Electroplaters' Society for June and July, 1922, and in Metal Industry for September and December, 1922.

[8] Metal Industry (New York), Udylite Co. Sold: Vol. 25 ,August, 1927, p. 354.

Miscellaneous uses.—Cadmium has been employed in the form of wire for coating or "metal spraying" plaster casts, statuary, and other objects with cadmium. Alloys containing cadmium are used in nonrusting hairsprings for watches and clocks. For the manufacture of electric-light filaments one of the earlier successful processes employed cadmium. An amalgam consisting of 42 per cent of cadmium, 53 per cent of mercury, and 5 per cent of bismuth can be impregnated with tungsten metal powder and then extruded through dies to produce a raw filament which is later heated to a high temperature to drive off the volatile metals. Five per cent of cadmium is sometimes added to aluminum powder to improve the color and luster and to make it more resistant to atmospheric influences.

Cadmium has been recommended for use in electric storage batteries. A battery having cadmium plates can be discharged completely and allowed to remain discharged indefinitely, whereas such abuse causes serious damage to ordinary lead batteries. As they cost fully twice as much as lead batteries, cadmium batteries have not been widely used, although there are several makes of miners' safety lamps employing an alkaline electrolyte, one nickel electrode, and, instead of the usual iron electrode of the Edison battery, a mixture of iron and cadmium in a thin perforated metal case. Monochromatic red light for scientific investigation in physical laboratories is produced by means of cadmium. In the quartz-cadmium vapor lamp developed by the United States Bureau of Standards the cadmium is alloyed with a very small fraction of 1 per cent of gallium, giving a long-lived lamp that does not become clouded by adhesion of cadmium vapor to the walls.[9]

During the World War cadmium was declared contraband by most of the belligerents. This may have been due in part to the use of cadmium as a substitute for tin, but, in addition to the ordinary industrial uses, cadmium was employed in smoke bombs and a cadmium band was placed on hard-jacketed cartridge bullets to take the rifling without undue wear on the barrel.

CADMIUM COMPOUNDS

Electrolytic cadmium is easily soluble in nitric acid, but without the aid of a catalyzer it becomes passive and practically insoluble in sulphuric or hydrochloric acid. Less pure metal can be dissolved in any acid, but it is ordinarily more convenient to produce the various salts of cadmium from cadmium oxide or from the sulphate solutions obtained by the treatment of cadmium residues with sulphuric acid. Most of the salts are soluble in water and dilute acids, and they are used principally as a source of the metal in cadmium plating and as pigments. Since cadmium is poisonous, almost its only use in medicine is as salicylate, which may be employed as an external antiseptic. The acetate finds a little use in dentistry. Several of the salts, particularly the alcohol-soluble halogen compounds, are employed in photography, and certain of them enter into the manufacture of fireworks and ceramics. Cadmium tungstate ($CdWO_4$) in the form of yellow crystals is used in the manufacture of fluorescent paint, and a borotungstate known as Klein's reagent is used in the preparation of a heavy solution having a maximum specific gravity of 3.28 and used for float-and-sink tests in ore dressing and mineralogy.

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[9] Bates, Frederick, The New Cadmium-Vapor Arc Lamp: U. S. Bureau of Standards Sci. Paper 371, 1920, pp. 43–50.

Cadmium sulphide (CdS), a brilliantly colored pigment variously known as cadmium yellow or jaune brillant, has been used extensively for painting street cars and passenger coaches on certain railroad lines because it is one of the most permanent pigments known, being unaffected by the sulphurous gases from coal smoke that blacken chrome-yellow pigment. As a pigment it finds use also in coloring soap and in calico printing. In pyrotechnics it is employed to produce a blue flame. It is also used fairly extensively to give color and luster to glass and porcelain. Added to rubber, it produces a yellow color without impairing the elasticity or strength. There is a small consumption in photography. Cadmium sulphide is sold in barrels or cans and ordinarily costs as much or more than the metal. It is prepared by passing hydrogen sulphide gas into a solution of cadmium salts. The color of the precipitate varies from lemon yellow through orange to brownish red, becoming darker as the acidity of the solution increases. The preparation of standard shades requires careful control. For many years cadmium sulphide constituted one of the largest outlets for cadmium, the consumption sometimes exceeding that of the metal itself in both quantity and value. In later years, however, the production of cadmium sulphide has failed to increase materially, although that of some of its other compounds and of the metal itself has grown rapidly.

Cadmium lithopone, also known as "cadmopone," is prepared like zinc lithopone by adding a solution of barium sulphide to the carefully purified sulphate. Since it contains only 30 per cent or less of cadmium, this pigment is much cheaper than cadmium sulphide, which contains approximately 75 per cent of the element, and for many purposes it is quite as satisfactory. It may be further cheapened by adding zinc lithopone or by precipitating both zinc and cadmium together,[10] as well as by mixing with other pigments. Cadmium lithopone, although produced in the laboratory many years ago, is a relatively new development in the industry, having been produced on a large scale only since 1925. It seems to be used rather extensively now in cream and ivory tinted paints and enamels.

Cadmium oxide (CdO) as a heavy brown powder can be prepared by heating the metal in air or by igniting the nitrate or carbonate. By heating the metal in a current of oxygen a dark-red crystalline sublimate is obtained. The hydrate [$Cd(OH)_2$] is on the market in the form of a white powder packed in glass bottles or boxes. It is prepared by adding caustic soda to a purified solution of cadmium and is used for the manufacture of cadmium salts and in the udylite and other cadmium-plating processes.

Cadmium sulphate ($CdSO_4$) crystallizes in several degrees of hydration. More or less pure solutions of cadmium sulphate are commonly employed for producing electrolytic cadmium and cadmium sulphide; but the quantity marketed as sulphate is quite small, being employed mainly in the manufacture of standard electric cells, such as the Weston cell used as a standard measure of electromotive force. It may be packed in tins or kegs.

Cadmium chloride, bromide, and iodide, the salts of the halogen acids, are remarkable chiefly because they behave in an anomalous way in water solutions owing to the formation of complex ions, particularly in concentrated solutions. Cadmium iodide, one of the few iodides soluble in alcohol, is a photographic chemical and may also be used in medicine. Cadmium potassium iodide ($CdI_2.2KI.2H_2O$) is a laboratory reagent. Cadmium chloride also is used in analytical chemistry and photography and is packed in wooden kegs for sale in larger quantities to manufacturers of cadmium pigments, for dyeing, and for calico printing.

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[10] Marston, John R., U. S. Patent 1399506, Dec. 6, 1921.

Cadmium nitrate [$Cd(NO_3)_2\ 4H_2O$] is used in ceramic industries for coloring glass and porcelain. It comes in tins and glass bottles, which must be well stoppered.

SUBSTITUTES

Cadmium, being a relatively new metal, has scarcely established itself as essential to the economic life of the Nation as yet. In most of its applications it has found a place largely as a matter of convenience and price. Although better suited to many of its uses than its substitutes, it is not irreplaceable. Bismuth not only supplements but may even replace cadmium in most of the easily melted alloys. In dental amalgam cadmium has been almost completely supplanted. For cadmium yellow may be substituted chrome yellows (chromates of lead, zinc, or barium), which, being much cheaper, are generally used for a first coat and are simply covered with a finishing coat of cadmium paint.

SOURCES

Greenockite (CdS), otavite (a basic carbonate), przibramite (a reddish zinc blende containing up to 5 per cent Cd), and a few other cadmium minerals are recognized, but apparently the only commercial sources of cadmium are zinc minerals. Most zinc ores contain cadmium in minute quantity, and the cadmium of commerce has all come from the following sources: (1) Zinc ores treated by fractional distillation; (2) bag-house fume from lead smelters treating zinciferous ores; and (3) residues from the purification of zinc solutions at electrolytic zinc or lithopone plants.

In Silesia cadmium is strictly a by-product of zinc smelting. Being concentrated in a brownish smoke which appears at the beginning of the distillation, it was formerly caught mainly in the "prolongs." Prolongs, which are essentially second condensers, are not employed in the United States because the small amount of zinc that escapes the adapter or first condenser does not pay for the additional labor involved. Even in Silesia prolongs have been discontinued except at works that make a specialty of zinc dust (blue powder). Usually, however, special arrangements are made for burning the vapor from the retorts and leading the fume to a central chamber.

Blue powder containing 4 and up to 8 per cent of cadmium has been the main source of cadmium in Europe. This powder and likewise the cadmium-bearing fumes are mixed with carbon and treated by repeated distillation for the recovery of their zinc and cadmium.

In the United States wet methods are used for the recovery of cadmium from flue dusts as well as from the other residues of zinc, lead, or copper production. At some stage in these various processes a purified sulphate (rarely a chloride) solution is obtained which contains essentially zinc and cadmium (and thallium). By one process the cadmium from these solutions is precipitated by zinc dust and this precipitate is redissolved in acid and electrolyzed. Aluminum cathodes are used and the deposited cadmium is periodically stripped, melted, and cast into sticks. This general process is in use at several American plants and at the electrolytic zinc plants at Trail, British Columbia, and Risdon, Tasmania. According to the other process the cadmium is precipitated from solution in the form of a sponge by means of zinc slabs or plates. This sponge is then distilled and the condensed cadmium is remelted and cast into sticks.

Fumes from brass works have been considered as potential sources of cadmium. Brass made from slab zinc containing as much as 0.5 per cent of cadmium has been found to contain scarcely a trace of the cadmium, because that element, being even more volatile than the zinc, is almost wholly volatilized when added to the molten copper. More than 10 years ago the Bureau of Mines estimated that 400 pounds of cadmium was lost daily at Waterbury, Conn., but now purer zinc is being used and the quantity of cadmium that escapes in this way is probably less than formerly. In any event, even when prices of cadmium were two or three times higher than they are now, it was not considered economical to try to recover this metal.

POTENTIAL SUPPLIES

The world's cadmium, as resources are now known, must come from zinc smelters and electrolytic zinc plants, and the ultimate potential supply may be considered as a function of the world output of zinc. While almost all zinc ores contain cadmium, the ratio of cadmium to zinc varies widely and is often altogether too small to be of value. Ores from the upper portions of weathered deposits are likely to be relatively higher in cadmium than those below, but there is no fixed relationship. In parts of the United States (Joplin) the cadmium-zinc ratio is 1 to 160; in Australia (Broken Hill) it is 1 to 250[11]; and in Upper Silesia, about 1 to 400. After examining analyses of zinc ores from various parts of the world, Boerling[12] and Lyzhin, in Cadmium, Mineral Resources of the Union of Socialist Soviet Republics, No. 20, came to the conclusion that the average ratio in the whole mass of ores was only 1 to 400. Although higher in some districts, in other regions it was considerably below the average. On the basis of the average ratio, the quantity of cadmium contained in zinc ores sufficient to furnish the present output of about 1,250,000 tons of slab zinc annually should be about 3,000 tons, but since not more than 40 or 50 per cent of the cadmium contained in such ores is on the average obtainable the maximum yearly production of cadmium can not exceed 1,000 to 1,500 tons. Budgen[13] placed the maximum visible output at 1,000 tons.

In view of the facts that the world's productive capacity has already reached almost the last-mentioned figure and that there are cadmium supplies in the form of residues that still remain untapped, these figures may appear somewhat overconservative. However, it should be remembered, on the one hand, that much of the new production is from electrolytic zinc plants where a high recovery of the cadmium is obtainable and, on the other hand, that an unknown amount of the present output is derived from residues and flue dusts that were accumulated in previous years and that will eventually be exhausted.

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[11] The ratio of cadmium to zinc actually produced in recent years in Tasmania has been approximately 1 to 300.

[12] The Future of Cadmium, digested from letter by N. Boerling: Mining Journal (London), vol. 160, Feb. 4, 1928, p. 106.

[13] Budgen, N. F., Cadmium: Its Metallurgy, Properties, and Uses: London, 1924, 239 pp.

PRODUCTION

Cadmium was discovered in 1817 by F. Stromeyer while investigating the cause of the yellow color of a zinc oxide, and its properties were extensively studied and widely known long before the end of the nineteenth century. Industrially, however, it is a comparatively new metal. In the United States, now by far the largest producing country, cadmium was first recovered commercially in 1906 by the Grasselli Chemical Co., and, although both the metal and its sulphide had been produced for many years previously in Germany, the growth of the industry has taken place principally within the last five years. World production was more than doubled with the advent of a new plant in Tasmania late in 1922. Another large accession occurred in 1925 when the Anaconda Copper Mining Co. commenced producing on a large scale, and still another new plant completed in 1927 adds Canada to the list of producing countries for 1928. With these various additions the world can now produce more than 1,000 tons of cadmium yearly as compared with about 274 tons in 1923 and 89 tons in 1920.

DOMESTIC PRODUCTION

Cadmium is produced in the United States both as metal and as compounds. Previous to about 1922 the only compound of any considerable importance was cadmium sulphide, but subsequently lithopone has been produced in increasing quantities and the introduction of cadmium electroplating has provided a fairly extensive market for the oxide and hydrate. In 1923 and 1924 the industry was passing through a period of readjustment, and producers hesitated to release figures of production and sales of cadmium in forms other than metallic cadmium. Since that time, however, the number of producers and the variety of products have increased so that figures showing the estimated metallic content of the compounds can be released without revealing confidential information. In 1926 and 1927 the compounds reported included cadmium sulphide, cadmium hydrate, cadmium oxide, and cadmium lithopone. Other salts apparently were derived from one or other of these compounds. Several producers reported sales of cadmiferous residues; but these sales, except for small amounts exported in certain years, appear to have been worked up by firms that report their production of cadmium and its compounds to the Bureau of Mines.

From the beginning of production in 1906 with 300 pounds of metallic cadmium, the output increased rapidly to 207,408 pounds of metallic cadmium, valued at $305,097, for 1917; in 1917 the output of cadmium sulphide amounted to 50,169 pounds (about 37,500 pounds metallic content), valued at $70,939. This quantity, although more than double the output of the pigment during any previous year, was slightly exceeded by the production in 1918, which was not again exceeded until 1921. The entire production of the United States up to the end of 1918 amounted to 817,766 pounds of metallic cadmium.

valued at $1,019,176, and 186,086 pounds of cadmium sulphide (about 140,000 pounds metallic content), valued at $221,704. The production for 1918 and later years is given in the table that follows:

Cadmium produced in the United States, 1918–1927

Year	Metallic cadmium		Cadmium compounds	
	Pounds	Value	Estimated cadmium content (pounds)	Value
1918	127,164	$188,203	[1] 38,800	[1] $70,315
1919	99,939	121,926	[1] 23,400	[1] 37,436
1920	129,283	151,261	[1] 24,100	[1] 37,274
1921	68,501	67,131	[1] 49,100	[1] 71,336
1922	131,590	143,433	[1] 101,100	[1] 152,295
1923	183,816	161,758	(2)	(2)
1924	129,328	77,597	(2)	(2)
1925	502,824	276,553	113,000	127,304
1926	810,428	429,527	166,600	130,483
1927	1,074,654	[3] 645,000	229,000	191,051

[1] Cadmium sulphide only.
[2] Bureau of Mines not at liberty to publish figures.
[3] Value in 1927 based on the average market quotation of 60 cents a pound.

WORLD PRODUCTION

Outside of the United States, Australia and Canada are now (1928) the principal cadmium-producing countries. Both have entered the field only recently. The Australian output comes entirely from the electrolytic zinc works at Risdon, Tasmania, where cadmium was first recovered in the latter part of 1922. The Canadian output is likewise a by-product of electrolytic zinc, being produced at Trail, British Columbia, where the Consolidated Mining & Smelting Co. of Canada in 1927 completed and put into operation a new plant. No production was recorded in 1927 or earlier; in 1928 production began at the rate of approximately 350,000 pounds a year.

Germany was the first country to produce cadmium on a commercial scale and for many years remained the only producer. The German output before the World War, however, came almost exclusively from that portion of Upper Silesia which, following the plebiscite in 1922, passed under the sovereignty of Poland. In this area cadmium was recovered by the zinc smelters, but although the output of zinc has been well maintained and even increased subsequent to the transfer the output of cadmium has dwindled to quite small proportions. The use of electrolytic methods instead of smelting is now being considered for reduction of the Upper Silesian ores. If adopted on an extensive scale, these methods would doubtless result in a large increase in cadmium recoveries in Poland. Since 1922 Germany has consumed a considerable part of the Upper Silesian output and, in addition, has been producing a variable quantity, usually only 1 or 2 tons annually, within her present boundaries, partly from imported cadmiferous residues.

Formerly Belgium produced cadmium regularly, probably from zinc dust, and in recent years has resumed production. France and Great Britain also produce certain amounts of cadmium, which are reported in their export statistics as being of domestic origin. All three countries import considerably larger quantities than they are exporting, so it is reasonable to assume, although statistics are not available, that their actual production is substantially in excess of the export figures that appear in the accompanying table. The growth of consumption in these countries is indicated by their import statistics. France, for example, in 1921 imported only 9,477 pounds of cadmium but since 1923 has been purchasing 10 to 15 times this quantity; in 1925 French imports were 171,471 pounds. Imports into Great Britain likewise have increased, amounting in 1923 to 63,310 pounds and in 1926 to 182,926 pounds.

World production of metallic cadmium, 1913–1927, by countries, in pounds

[Compiled by L. M. Jones, of the Bureau of Mines]

Year	Australia (Tasmania)	Belgium [1]	France [1]	Germany	Great Britain [1]	Poland	United States
1913	----------	(2)	661	81,994	(2)	(3)	54,198
1914	----------	(2)	661	86,362	(2)	(3)	91,409
1915	----------	(2)	----------	82,177	(2)	(3)	91,415
1916	----------	(2)	220	127,341	(2)	(3)	135,212
1917	----------	(2)	441	172,284	(2)	(3)	207,408
1918	----------	(2)	220	235,542	(2)	(3)	127,164
1919	----------	(2)	5,952	85,396	(2)	(3)	99,939
1920	----------	(2)	220	45,971	3,327	(3)	129,283
1921	----------	(2)	----------	47,501	2,884	(3)	68,501
1922	80,640	(2)	----------	[4] 4,409	2,430	[5] [6] 61,866	131,590
1923	275,518	(2)	220	2,205	1,537	[6] 84,216	183,816
1924	356,898	[7] 205	220	2,529	8,547	[6] 41,233	129,328
1925	400,661	1,102	441	(2)	4,298	7,837	502,824
1926	358,912	661	661	(2)	17,483	11,574	810,428
1927	346,773	(2)	(2)	(2)	22,879	13,558	1,074,654

[1] Exports of domestic products. Production figures not available.
[2] Data not available.
[3] Included under Germany.
[4] Exclusive of that portion of Upper Silesia allocated to Poland in 1922.
[5] Includes output for entire year of that portion of Upper Silesia allocated to Poland in June, 1922.
[6] Includes small production from one zinc plant in Cracow.
[7] Figures cover exports from Nov. 10 to Dec. 31, inclusive; data for entire year not available.

ORGANIZATION

Cadmium, being a by-product, is produced mostly by large smelting and chemical companies having varied interests. No one company dominates the domestic market. The following list gives the names of the American producers in 1926 and 1927 and the nature of the plant whence the cadmium residues were obtained:

Producers of cadmium or cadmium products in the United States, 1926–27

Company	Location of plant	Associated plant
American Smelting & Refining Co	Denver, Colo	Lead smelter.
Anaconda Copper Mining Co	Great Falls, Mont	Electrolytic zinc plant.
Chemical & Pigment Co. (Inc.)	Collinsville, Ill.[1]	Lithopone plant.
Do	St. Helena, Md	Do.
Eagle-Picher Lead Co	Hillsboro, Ill.[1]	Do.
Do	Henryetta, Okla	Zinc smelter.
Grasselli Chemical Co	Cleveland, Ohio	Chemical works and lithopone plant.
Krebs Pigment & Chemical Co	Newport, Del.[1]	Lithopone plant.
New Jersey Zinc Co	Palmerton, Pa	Do.
United States Smelting, Refining & Mining Co	Midvale, Utah	Lead smelter.

[1] Cadmiferous residues only.

IMPORTS

Previous to 1915 cadmium from Germany supplemented the growing production from domestic plants. In 1906 the imports of cadmium reached a maximum of 13,808 pounds, having a value of $10,522. In the following year, after the advent of domestic production, they dropped to 1,953 pounds, valued at $1,633. After rising to 8,862 pounds in 1909 they declined more or less gradually until, following the outbreak of the war, they disappeared. Imports were resumed in 1921 but on a much smaller scale, none being imported in 1926 and only negligible quantities in 1923 and 1925. In 1924 there was a rather large shipment from Australia, but due to the remarkable expansion of domestic production even this record quantity constituted but a relatively small portion of the domestic supply.

Prior to July, 1909, the value only of cadmium imports was recorded by the United States Bureau of Foreign and Domestic Commerce. For the earlier years the quantity was estimated by dividing the value of the imports by the average price of cadmium for the corresponding year in Germany.

Imports of metallic cadmium were exempt from duty from 1861 until 1922 when, under the Fordney-McCumber Tariff Act, they were made dutiable at 15 cents per pound.

Imports of cadmium sulphide and other compounds are not given separately in the trade statistics, being included either as chemical compounds, not specially provided for (dutiable at 25 per cent ad valorem under the tariff act of 1922), or as pigments (also dutiable at 25 per cent ad valorem, except artists' colors, which are dutiable at higher rates).

Metallic cadmium imported for consumption in the United States, 1918–1927

Year	Pounds	Value
1918–1920		
1921	101	$216
1922	2,240	2,434
1923	16	119
1924	1,102	$743
1925	5	6
1926		
1927	22,400	13,172

EXPORTS

Statistics of the exports of cadmium are not separately recorded by the Bureau of Foreign and Domestic Commerce, but it is known that a considerable quantity of domestic stick cadmium was exported during the World War. In 1916, for example, there were exported through the port of New York 33,244 pounds in October, 4,900 pounds in November, and 1,044 pounds in December. Between February 1, 1918, and January 31, 1919, 42,320 pounds of metallic cadmium, valued at $63,020, or $1.49 per pound, was licensed for export to France, Norway, Canada, Great Britain, and Italy, and it is believed that all of this cadmium was exported.[14] Other quantities doubtless find their way to foreign consumers through other agencies. Competition from Australian production has had an adverse influence on the export trade since 1922.

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[14] Data furnished by U. S. Tariff Commission.

In 1914, 4,225 pounds of cadmium residues were sold for export, and variable quantities of such residues have been exported in other years.

MARKETS AND PRICES

Virtually since the beginning of cadmium recovery in the United States the American market has been largely self-contained. At first the domestic product was much purer than the German product and was preferred by most consumers because of its superior quality. More recently, however, the foreign product, coming now (1928) principally from electrolytic plants in Tasmania and Canada, is equal in quality to the domestic.

Under these circumstances, and as long as no large exportable surplus develops, the price of cadmium in the United States is likely to be the world price plus the duty of 15 cents per pound and the cost of importation. For a period just previous to the European war the price in the American market was lower than that of the foreign-made product in Germany, but since 1922 the world price has been made largely by the Tasmanian producers.

The market history of cadmium provides excellent examples of the reactions of supply and demand upon price and conversely of price upon supply and demand. Cadmium is a by-product, and, once committed to the recovery of the metal, producers are inclined to maintain production as long as the price obtained covers their actual out-of-pocket expense for working up the cadmium-bearing residues which would otherwise have to be stored or simply thrown away. In other words, the supply during certain periods tends to be governed by factors other than demand. The demand, on the other hand, is extremely flexible. For many purposes satisfactory substitutes are available at competitive prices, and consequently the demand for cadmium tends to rise or fall in inverse proportion to the price. In Paris a Cadmium Institute, founded early in 1927, has succeeded in awakening new interest among potential consumers of cadmium[15] and probably has thereby helped to increase the demand and hence the price. In the United States, however, and evidently also abroad, there is no effective control either of production or of prices by producers. As a general rule prices move slowly because all the producing companies are financially strong and are quite capable of financing their stocks over a temporary lull in the market. Nevertheless cadmium prices may be expected to reflect, within a relatively short period, the ratio of demand to supply.

In 1875 cadmium, at that time wholly of German origin, was quoted in the United States at $3.20 per pound. In 1886 the average value of the total output of Germany was 80 cents per pound, and in 1890 and 1892 it fell to 38 cents. Because of certain purchases by the German Government, the price rose to $1.23 in 1897, and in 1906, when the United States began producing cadmium, the German average price was 76 cents.[16] In 1910, when the German price went down to 43 cents, the corresponding American quotation was 55 cents. These were minimum figures, for, despite the marked increase in the American output, the price in 1913, as indicated by the average value reported for production, was 77 cents in the United States and 78 cents in Germany.

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[15] Marcus, Dr. Alfred, Commercial Outlook for Cadmium: Min. Jour. (London), Aug. 4, 1928, p. 669.

[16] Prices for earlier years from C. E. Siebenthal, Mineral Resources, 1919, pt. 1, p. 5.

Previous to the World War prices of cadmium for several years ranged between 55 and 80 cents per pound, production and consumption being well balanced at much lower figures than at the present time. The scarcity of tin during the war caused a sudden demand which jumped the price of cadmium to $1.50 and $2 per pound. This large increase, in turn, encouraged new producers to equip themselves to recover the metal. Cadmium is a potential by-product of many industries in which it is still not recovered. Moderately large quantities of cadmiferous material are thrown away every year, and up to certain limits the output of cadmium in the United States can be expanded rather quickly provided prices promise to prove remunerative over a sufficiently long period to justify the necessary investment in plant equipment and sales effort. Much of the recent expansion in cadmium consumption is the result of research by the larger producing companies that, fearing the collapse of demand after the war, began in 1918 to seek new uses for the metal. The adoption of cadmium plating by the automotive industries is probably the largest factor in sustaining the demand and hence the price. At the same time it has also stimulated production, as evidenced by the remarkable increases registered during the past five years.

In 1922 it was freely predicted that the output from the Tasmania plant would break the market, and this proved to be the case. Early in 1923 prices in the United States dropped rapidly from over $1.15 per pound to 75 cents. Later the price fell further to slightly under 60 cents, where it eventually reached equilibrium as demand increased to keep pace with the advancing production in the United States and abroad. In June, 1925, the New York price was 60 cents and the London quotation 52½ cents per pound. Subsequently the American price has remained practically stationary while the price in London, which represents the European level, fluctuated around 2 shillings or approximately 40 cents per pound until early in 1928, when an upward movement started which brought the price to about 3 shillings in July.

Beginning in 1906, after each accession of new production the price fell for a time; but always, after finding a new equilibrium, it has risen again to a point that tempts still another producer to venture into the field.

High and low prices per pound of metallic cadmium at New York and London, 1919–1927

Year	New York[1]		London[2]				Year	New York[1]		London[2]			
	High	Low	High		Low			High	Low	High		Low	
			S.	*d.*	*S.*	*d.*				*S.*	*d.*	*S.*	*d.*
1919	$1.50	$1.40	8	3	6	5	1924	$0.80	$0.55	3	0	2	6
1920	1.50	1.40	6	6	6	5	1925	.60	.60	2	6	1	9
1921	1.50	1.10	6	5	5	11	1926	.60	.60	1	11	1	9
1922	1.25	1.10	5	11	5	4	1927	.60	.60	1	11	2	0
1923	1 15	.75	5	3	3	0							

[1] Engineering and Mining Journal, New York.

[2] Mining Journal (London).

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Long before the metal itself became important commercially an extensive literature was built up on cadmium and its compounds. Lists of books and the more important articles on cadmium have been given in the chapters on cadmium in Mineral Resources for previous years, especially those for 1908, 1918, 1921, and 1924. The following list, except under the head "General references," includes only selected articles which have appeared since 1924.

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Budgen, N. F. Solders containing cadmium. Metal Ind. (N. Y.), vol. 23, 1925, pp. 104–106.

The properties, preparation, and uses of numerous binary, ternary, and quarternary solders containing cadmium are given.

Capua, C. di. Le systéme ternaire, plomb, cadmium, thallium. Gazz. chim. ital., vol. 55, April, 1925, pp. 280–290. Abstract in Bull. soc. chim. France, vol. 39–40, March, 1926, p. 271.

Chemical Age, London. Electrolytic processes. Vol. 16, April 2, 1927, p. 31.

According to a patent by E. C. R. Marks, London, from the Grasselli Chemical Co., Cleveland, Ohio, cadmium is deposited from solutions containing, besides cadmium, an ammonium compound, a cyanide, and an alkaline agent. Under these conditions the deposition of zinc is inhibited so completely that the method may be applied to the quantitative determination of cadmium in presence of zinc. Under the latter condition, after the cadmium has been deposited, caustic alkali is added, and the solution is boiled to expel ammonia and electrolyzed again for deposition of the zinc. When the method is used for cadmium plating the usual additions of colloids may be made to the bath. The cadmium deposits so obtained are stated to be more resistant to corrosion than cadmium deposits containing zinc.

Cournot, M. The future for cadmium. Queensland Govt. Min. Jour., vol. 29; February, 1928, p. 59.

Dorno, C. (The use of the cadmium cell for measurement of ultra-violet radiation.) Strahlentherapie, vol. 25, pp. 361–362; Bull. Hyg., vol. 3, 1928, pp 27–28; Chem. Abs., vol. 22, No. 9, May 10, 1928, p. 1540.

This cell is most sensitive between 2,800 and 3,500 Å. U Its insensitivity to infra-red is advantageous.

Electroplaters' and Depositors' Technical Society. Discussion of paper by E. J. Dobbs on Cadmium Deposition. Met. Ind., vol. 29, October 29, 1926, pp. 412–414.

Cadmium from Risdon, Tasmania, is obtained as a by-product in the electrolytic zinc process, being itself deposited electrolytically. The cadmium content runs consistently 99.95 per cent, the impurities being lead, iron, zinc, and copper. Representative analyses are—

	Actual analysis, per cent	Typical analysis, per cent
Lead	0. 0067 to 0. 0152	0. 0114
Copper	. 0025 to . 0174	. 0080
Zinc	. 0100 to . 0125	. 0107
Iron	. 0002	. 0002
Cadmium	99. 97559 to 99. 9599	99. 9697

Freitag, —. (Cadmium and cadmium yellow.) Farbe u. Lack, 1925, p. 606; Chem. Abs., vol. 20, March 20, 1926, p. 995.

A review of cadmium-production statistics and the resultant effect on the price and commercial availability of the metal and of cadmium yellow, with a review of recent patents for producing cadmium pigments.

Friedrich, Walter. Lead-cadmium alloys. United States Patent 1645098, October 11, 1927.

Cable casings are formed of alloys containing lead 99 to 99.8 and cadmium 0.2 to 1 per cent.

Geppert, J. Lead alloy for bonding glass. United States Patent 1584922.

Bi 2 to 16, Pb 62 to 72, Sb 16 to 24, and Cd 0.5 to 7.5 parts.

Gleason, E. C. Sterling silver. United States Patent 1191890, July 18, 1916.

Ag 925 is alloyed with Cd 75 parts to produce an alloy for tableware that will not be discolored by fruit acids.

Gronover, A., and Wohnlich, E. (Cadmium as a plating metal for utensils.) Ztschr. Unters, Lebensm., vol. 53, 1927, pp. 392–396; Chem. and Ind., Brit. Chem. Abs., vol. 46, September 2, 1927, p. 657.

Hanley, H. R. Production of electrolytic cadmium. Chem. and Met. Eng., vol. 23, December 29, 1920, pp. 1257–1264. 6 illus., 1 flow sheet.

Describes the character and production of Cd from bag-house dusts. The dusts carry, besides Cd, Zn, Cu, Fe, Mn, As, Bi, Pb, Co, Ni, Tl, Te, Se, Au, Ag.

Hoff, C. M. Cadmium plating. Canadian Patent 266722, December 14, 1926; Chem. Abs., vol. 21, March 20, 1927, p. 862.

A compound for use in the electrodeposition of Cd comprising a Cd compound, an NH_4 compound, a caustic alkali, and an alkali metal cyanide.

Humphries, C. H. Cadmium plating resists rust. Iron Age, vol. 120, 1927, pp. 401–402.

Industrial Australian and Mining Standard. Canadian cadmium plant. Vol. 79, May 17, 1928, p. 473.

Jenkins, C. H. M. The constitution and physical properties of some of the alloys of copper, zinc, and cadmium. Chem. News, vol. 135, December 9, 1927, p. 384. (Abstract of paper before Inst. of Metals, Derby, September 6–9, 1927.)

Jordan, Louis, and others. Tarnish-resisting silver alloys. United States Bureau of Standards Technol. Paper 348, 1927, pp. 348–496.

Joseph, R. P. (Omaha, Nebr.). British Patent 280073, February 7, 1927; Chem. Age, vol. 18, No. 445, January 7, 1928, p. 7.

Silver alloys in which silver predominates and which are substantially non-tarnishing contain tin, zinc, aluminum, and gold; the tin and zinc can be replaced by cadmium; preferably the tin and zinc together are greater in quantity than the gold and aluminum, the smallest amount of the latter metal being present. A suitable alloy consists of 925 parts of silver, 6 parts of gold, 1 part of aluminum, 41 parts of tin, and 27 parts of zinc; advantageously the alloy metals may be first used together and then fused with the silver.

Leach, R. H. Silver alloys. United States Patent 628673, May 17, 1927.

Alloys that may be used for tableware, etc., comprise Ag together with Cd 1 to 7 and Sb 6.5 to 0.5 per cent.

Loven, C. H. Cadmium plating in quantity production. Met. Ind. (New York), vol. 26, No. 6, June, 1928, p. 252.

Shows value as protection against rust; describes methods of plating; explains means of control; and gives analysis of cadmium-plating solutions.

Marcus, Dr. Alfred (Berlin). Commercial outlook for cadmium. Min. Jour. (London), vol. 162, No. 4850, August 4, 1928, p. 669.

Milliau, E. The action of gelatin in the electrodeposition of cadmium. Bull. soc. chim. belg., vol. 34, 1925, p. 143; Chem. Abs., vol. 19, August 10, 1925, p. 2302.

Points out that addition of gelatin will produce smooth coherent deposits of Cd only if the Cd salt of a strong acid (H_2SO_4, H_2SiF_6) is being electrolyzed in the presence of an excess of the same acid. If AcOH is used, the gelatin has no effect.

Nature. Cadmium photo-electric cell. Vol. 118, 1926, p. 283.

Parker Rust Proof Co. Rust-proofing iron. British Patent 273168, February 16, 1927; Chem. Abs., vol. 22, No. 10, May 20, 1928, p. 1754.

A rust-proofing bath is formed by dissolving in water the crystallized di-H phosphates or the phosphates of Fe, Zn, Mn, or Cd.

Passalacqua, A. Solder for aluminum. Chem. Abs., vol. 21, July 20, 1927, p. 2247.

Pierce, H. C. Cadmium plating. Brass World, vol. 22, pp. 397–399; Mon. Rev. Am. Electroplaters' Soc., vol. 13, 1926, pp. 8–15; Chem. Abs., vol. 21, February 20, 1927, p. 535.

The development of commercial electroplating is reviewed. The deposits formerly obtained were always soft, dull gray, and could be buffed only with difficulty, until it was discovered that the addition of small quantities of such materials as wool dissolved in hot NaOH, casein, condensed milk, licorice powder, and powdered tobacco gave lustrous deposits which could be buffed easily.

Rawdon, Henry S. Note on the protection of iron by cadmium. Abstract of paper read before Electrochemical Society, April 22, 1926; Met. Ind., vol. 24, 1926, p. 191.

Smith, W. Coating and impregnating metals and other materials with aluminum or aluminum alloys. British Patent 279273, December 14, 1926; Chem. and Ind., vol. 46, December 23, 1927, p. 943.

Iron or steel articles are coated with cadmium by electrodeposition, then coated with aluminum by immersion in molten aluminum (or its alloys), or by exposure to aluminum vapors. In both cases the cadmium is removed completely from the article, by dissolution in the aluminum in the first case and by volatilization in the second.

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Cd. is used as sole oxidizing agent in the manufacture of alloys containing Cu, Mg, and Cd. Cu may be melted and then deoxidized with an alloy containing Cu 90 and Cd 10 per cent; an alloy containing Cu 16.5, Mg 3.25, and Cd 5 parts is then added to produce an alloy of the desired composition. Mg may be added previous to the addition of the alloy of Cu, Mg, and Cd.

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Treats of cadmium-bearing minerals and gives Cd content of Silesian and American zinc ores (pp. 3 and 4). The highest Silesian zinc blende carried 0.259 per cent Cd; a calamine carried 0.306 per cent. The lowest zinc blende carried 0.004 per cent. For the United States, gives analyses by Waring, given by Siebenthal. The average for 2,145 shipments from the Joplin district in 1903 was 0.388 per cent cadmium; in 1904, 0.304 per cent. From Webb City the average

of 2,691 shipments was 0.43 per cent. This average of 10,906 shipments, mostly carloads, was 0.358 per cent. "Turkey fat" from the Morning Star mine, north Arkansas, carried 0.72 and 0.79 per cent. Gives content of zinc ores from other countries. Zinc ore from Morro do Bulle Ouro Prato, Brazil, was said to contain 2.4 per cent Cd. Ore from Sardinia is said to carry as much as 1.66 per cent. Speaks of cadmium-bearing lead ores and cadmium-bearing copper ores (p. 6), but admits that it is only due to the zinc blende present. Cd has been found also in coal and probably is associated with pyrite. Quotes cadmium as having been found in waters; 0.10 per cent in water of a spring on Shoal Creek, Mo., and smaller quantities elsewhere. Treats of the metallurgy of cadmium, and incidentally that of zinc (pp. 70 and 80), not treated very extensively. Treats of the physical and chemical properties of cadmium (pp. 81 to 115); the determination of cadmium (pp. 115 to 126); alloys (pp. 127 to 191); and quotes a list of fusible alloys on page 188. Electrodeposition is described on pages 192 to 202; summarized uses, pages 203 to 225.

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LEAD

By Lewis A. Smith[1]

STATISTICAL SUMMARY

Lower prices for lead in 1927 resulted in some curtailment of production in the tri-State area but on the whole did not greatly affect the domestic situation as regards production or consumption. Instead of being stimulated by the reduction in price, the consumption of primary metal actually decreased more than 54,000 tons. The salient statistics of the lead industry in the United States for 1926 and 1927 are compared in the following table:

Salient figures of the lead industry in the United States, 1926 and 1927

	1926	1927
Production of refined primary lead:		
From domestic ores short tons	680, 685	668, 320
From domestic and foreign ores do	798, 941	796, 530
Average selling price per pound of refined lead cents	8. 0	6. 3
Value of refined primary lead produced from domestic ores	\$108, 910, 000	\$84, 208, 000
Imports of lead in ore, base bullion, etc.:		
General short tons	147, 554	161, 389
For consumption do	48, 662	47, 906
Exports of lead:		
From domestic ores do	4, 276	2, 533
From foreign ores do	67, 660	122, 734
Stocks of lead in bonded warehouse:		
Jan. 1 do	8, 162	10, 711
Dec. 31 do	10, 711	9, 464
Total supply of refined primary lead do	818, 255	809, 708
Lead withdrawn do	100, 602	146, 296
Apparent consumption of refined primary lead [1] do	717, 653	663, 412
Antimonial lead produced do	22, 524	24, 347
Recovery of secondary lead do	277, 300	276, 000

[1] Exclusive of foreign lead exported in manufactures and upon which drawback was paid.

The production of refined primary lead from domestic ores in 1927 decreased 1.8 per cent from 1926, but the decrease in total primary lead from domestic and foreign sources was very small. The average selling price of lead decreased 1.7 cents per pound, or 21 per cent, from 1926 and accounted largely for the marked decrease of nearly \$25,000,000 in the value of refined lead produced from domestic ores. Most of the smelter production from domestic ores came from six States, ranking as follows in importance: Missouri (30.7 per cent of the total), Utah (22.7 per cent), Idaho (22 per cent), Oklahoma

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[1] The statistics on domestic production were prepared by H. M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

(9.6 per cent), Colorado (5.4 per cent), and Montana (3.4 per cent). These six States account for nearly 94 per cent of the total of 684,165 tons from domestic sources; only Idaho and Utah showed substantial increases. The total imports of lead in 1927 were nearly 14,000 tons in excess of those in 1926, and the exports were 53,000 tons more than in 1926. Practically all of the lead recovered from ore produced in the United States is used at home; only about 2,500 tons of lead from domestic ores was exported in 1927.

GENERAL FEATURES OF LEAD INDUSTRY IN 1927

The production and the apparent use of lead both declined in the United States in 1927 but probably did not in the rest of the world. Available figures for world output and consumption indicate a slight increase over those for 1926, a record year. No new factors appeared in the situation. The competition of substitutes for lead and the return of secondary metal continued to trouble producers, but even along these lines that would tend substantially to alter the trend that has been under way for several years there were no outstanding developments. There is reason to believe that the apparent drop in domestic demand represents in part at least nothing more than the adoption of hand-to-mouth buying policies on the part of certain consumers who, in view of market conditions and improved transportation services, considered it no longer necessary to maintain as large stocks as formerly. Flotation, notably selective or differential flotation, made further advances, yielding richer concentrates and higher extractions at lower costs.

CHANGES IN USES

For several years the American Bureau of Metal Statistics has published a table that shows the approximate amounts of lead consumed in the various uses in which that metal is required. By translating these figures into percentages an idea may be gained as to the relative changes in distribution according to the various outlets for lead.

Percentage of total lead consumed in the United States, 1923–1927, by uses

Use	1923	1924	1925	1926	1927
Storage batteries	18.62	20.93	21.02	21.09	20.81
Cable coverings	17.06	17.00	18.21	20.53	19.15
White lead	16.93	18.47	15.29	13.32	14.98
Building	9.76	10.23	10.32	10.40	10.46
Litharge and red lead	5.99	4.19	4.90	4.00	4.52
Solder	3.91	3.69	4.09	4.11	4.16
Ammunition	5.21	3.32	3.68	3.55	4.04
Bearing metal	3.65	3.94	3.97	4.00	3.69
Foil	4.34	4.31	3.80	3.89	3.57
Calking	3.26	3.26	3.50	3.55	3.57
Castings	1.95	1.85	2.10	2.00	2.02
Type metal	1.56	1.60	1.75	1.78	1.90
Automobiles	1.35	1.32	1.49	1.85	1.43
Terneplate	.60	.50	.53	.45	.46
Railway cars	.78	.55	.52	.42	.32
Locomotives	.27	.14	.09	.11	.08
Shipbuilding	.01	.02	.01	.01	.02
Miscellaneous	4.75	4.68	4.73	4.94	4.82

Four of the outlets alone, it will be noted, account for almost two-thirds of the total consumption. As prepared by the American Bureau of Metal Statistics the estimates of consumption by uses for 1927 add to only 840,950 tons, or almost 100,000 tons less than the total lead available for consumption in the United States, as indicated by production and trade figures now available. Assuming that the relative proportions of lead used for the various purposes are correct but using the larger figures for indicated consumption, the lead required by these principal consuming industries in 1927 may be estimated at approximately 195,000 short tons in storage batteries, 180,000 tons for cable coverings, 141,000 tons in white lead, and 98,000 tons in building.

Four years is scarcely long enough for definite trends to become established, but the percentages in the foregoing table indicate that, relative to other uses, the consumption of lead is on the increase in cable coverings and on the decrease in the manufacture of white lead. In building there is a consistent though slight upward tendency. For storage batteries, on the other hand, the upward trend of former years seems to have reached its climax. The gross consumption of lead for the last-named purpose is affected by the more extensive use of "socket power" for radio receiving sets where electricity is available, thus eliminating a large number of storage batteries. A more important factor, however, is the recovery of scrap. The major part (estimated at about 95 per cent) of the lead used in storage batteries is returned to the industry within two to three years after its initial utilization in this way. Hence, despite the growing number of automobiles and radio receivers in use, the amount of primary lead required in storage battery manufacture has dropped sharply. However, the extent to which old battery plates are replacing virgin metal is not revealed by available figures; the percentages as given in the table are based upon estimated total consumption, including lead of both primary and secondary origin and antimonial lead.

As compared with 1926 there was a drop in the demand for cable coverings in 1927. Nevertheless, the outlook for increased demands in this field, the second largest use of the metal, is generally considered favorable. Although undersea cable coverings are apt to be left in place for many years, land cable and transmission lines are constantly being raised, enlarged, and replaced. The lead in them is readily reclaimed; but, since new and larger lines are continually being added as the use of electricity becomes more and more widespread, consumption in this field should increase, provided, of course, that substitutes to replace lead are not found.

In the manufacture of white lead, formerly by far the leading outlet for the metal, there was an apparent slight increase in consumption in 1927, offsetting in part the downward movement of recent years. In Europe the use of white lead in several countries has been unfavorably affected by legislation that prohibited its use, particularly for interior painting, because of alleged poisoning of the workmen applying it. In the United States the fact that this pigment has failed to share in the fast-growing demand for paint products is simply the result of active competition from other substances, notably zinc-white, lithopone, barium pigments, titanium oxide, and cellulose lacquers. Of these substitutes cellulose lacquers, which now find such extensive use in the automobile industry, and titanium oxide are newcomers in the field. The latter after becoming moderately well established abroad has made steady advances in this country. The importance of this new competition may be gauged by the fact that the National Lead Co., a leading manufacturer of lead pigments, has purchased the properties and business of one of the largest titanium pigment companies in Europe and has obtained control of one of the largest producers of such pigments in this country. It is evident that the prospects for the wider use of white lead are not bright.

As regards the use of primary lead in the building industry the competition from reclaimed lead and substitute materials is likewise apparent. Because of its resistance to corrosion and its workability lead is used in roofing sheets, cornices, electric cables and wiring, drainage and sewerage pipes, plumbing fixtures, etc. Brass, copper, and zinc are all finding increased application in building, and the brass manufacturers especially are advertising extensively and effectively. However, the American people are beginning to demand more permanence in their buildings. For this reason, even though lead may be replaced by other materials for some purposes, it is likely to hold its own and possibly may find further uses in the construction industries.

In the numerous minor fields of use the only recent development that calls for special comment seems to be the replacement of solid bearings by roller bearings. Even some of the railway companies have equipped their rolling stock with these new bearings which, though much more expensive in initial cost, are deemed advantageous because they reduce friction and consequently contribute to greater operating economy.

Lead is relatively a cheap metal, and for this reason even a decrease in its price does not tend largely to encourage its use to replace other metals. Increases in the price of other metals, however, do tend to encourage the substitution of lead therefor. In the manufacture of foil, for example, either (1) pure tin, (2) pure lead, (3) lead covered with tin on both sides, or (4) aluminum may be used. When the price of tin advances to 50 cents or over per pound, foil manufacturers are disposed to replace it as far as possible by lead. Since ordinary solder contains lead and tin in equal proportion, other solders, such as cadmium solders, which contain 85 to 95 per cent of lead, or "amaloy," a new invention containing 98 per cent or even more of lead and only 1 per cent or less of tin (a small amount of phosphorus being added to produce the desired properties), tend to be used when tin becomes relatively more costly.

NEW USES

In addition to amaloy, which is being used for soldering work in the automobile industry and in the manufacture and installation of electrical equipment, a few other new uses have come into prominence lately, and some of these may develop into important items of consumption. In building construction interest is evoked by the use of lead mattresses to act as shock absorbers between the foundations and the steel framework of skyscrapers. In one building in New York about 55 tons of lead appears to have been used for this purpose.

In the pigment field a new lead preparation called "subox" has been introduced. This preparation, which consists of very finely divided particles of lead suboxide (Pb_2O) suspended in linseed oil, can be sprayed or applied with a brush upon any surface. After being applied it undergoes a slow transformation, resulting in a film of metallic lead held firmly as a protective coat by the oxidized oil.

SELECTIVE FLOTATION

UNITED STATES

No important new lead districts have been discovered in recent years, but the world's resources have been largely expanded as a result of more efficient metallurgical processes. As is well known, lead and zinc are typically associated in nature. Ores of both metals are mined together in many parts of the world, but previous to the advent of the Wilfley table in the nineties the separation of the lead and zinc was incomplete and wasteful. In the Mississippi Valley lead and zinc have been separated with fair success by means of jigs, but in the western United States the lead and zinc and not infrequently also copper and iron sulphides are so intimately mixed that relatively fine grinding is necessary to liberate the individual minerals. The development of methods of treating the complex ores of the Rocky Mountain States is one of the most interesting chapters in the history of ore dressing. The shaking table made possible economic operation of an enormous number of deposits but never succeeded in effecting a thoroughly satisfactory separation. Zinc blende in particular, being intermediate in specific gravity between the lead and the gangue minerals, was not recovered satisfactorily. The zinc that accompanied the lead concentrate was normally lost in smelting, was not paid for, and if present in any considerable amount was penalized.

Even before the World War flotation was being employed to improve the recovery of sulphide minerals, particularly as an accessory process for the treatment of slimes, but it was not until after 1918 that methods were devised whereby the various sulphides present in complex ores of lead and zinc could be separated commercially by flotation. In North America, the Sullivan mine in British Columbia was the first to introduce selective flotation of lead and zinc on a large scale, and it was not until 1924 that the effects of this new method became apparent in the production statistics of the United States. The fact that a reasonably clean separation can be effected by this relatively simple process has made possible the profitable operation of many mines that otherwise would have been forced to close down as a result of the price levels for lead and zinc that prevailed during the greater part of 1927. A correlative effect has been to bring into the category of commercial ore material that was not previously workable.

In the Mississippi Valley and Eastern States, where the ores are less complex, the effect of this new method has not been revolutionary. In consequence, operators in these States have fallen behind their western competitors. The reasons for this are somewhat complicated. By using selective flotation the mills in the Western States are making cleaner products and recovering more zinc. Instead of being penalized as formerly the zinc thus saved is now being paid for and contributes to the operating income of the mining companies. Moreover, much of this new western zinc, being refined electrolytically, is produced so cheaply that under existing conditions it introduces serious competition as against the product of retort smelting in Central and Eastern States. This situation relates primarily to zinc but nevertheless reacts upon the lead situation. To be sure, the Western States have increased lead production but did so essentially because they have been able vastly to increase their zinc output. In the Mississippi Valley, on the other hand, the considerable proportion of the lead production coming from small mines that are dominantly zinc producers has been curtailed. The fact that the Mississippi Valley ores do not contribute by-product credits in the form of gold and silver values is a further handicap, as it makes the eastern miners depend even more than the western operators upon the prices of lead and zinc. As noted elsewhere, the output of lead in the Mississippi Valley and Eastern States, as measured by smelter records, decreased from 313,891 tons in 1926 to 288,347 tons in 1927, or 8.1 per cent.

The American Bureau of Metal Statistics has canvassed the principal western producers to determine the amount of lead and zinc ores beneficiated by flotation. The following table shows the rapid increase in lead output by selective flotation and other flotation methods. The production of 220,000 tons of lead in flotation concentrates in the Western States in 1927, accounted for by the incomplete canvass above cited, indicates that at least 56 per cent of the lead from western ores was recovered by flotation.

Lead and zinc concentrates directly obtained in Western States by use of flotation methods, 1921–1927

[Based on figures compiled by the American Bureau of Metal Statistics and published in its Year Book for 1927, p. 70]

Year	Lead concentrates							Lead content of zinc concentrates	
	Total produced			Lead content					
	Short tons	Increase		Per cent	Short tons	Increase		Short tons	Per cent
		Short tons	Per cent			Short tons	Per cent		
1921	107,237	---------	---------	41.87	44,904	---------	---------	4,457	11.60
1922	117,405	10,168	9.48	41.85	49,131	4,227	9.41	6,105	7.43
1923	166,777	49,372	42.05	42.07	70,166	21,035	42.81	11,181	6.60
1924	235,049	68,272	40.94	41.17	96,774	26,608	37.92	14,368	6.30
1925	320,513	85,464	36.36	43.45	139,264	42,490	43.91	11,064	4.36
1926	392,220	71,707	22.37	46.67	183,047	43,783	31.44	16,722	4.13
1927	451,617	59,397	15.14	48.77	220,236	37,189	20.32	12,293	2.46

The first significant feature is the increase of western concentrates being produced by flotation (mainly selective). The greatest absolute increase was made in 1925, when an increase of 85,464 tons of concentrates was obtained. Following that lesser increases of 71,707 tons in 1926 and 59,397 tons in 1927 were made. The increase of

1922 over 1921 was 9.48 per cent; of 1923 over 1922, 42.05; of 1924 over 1923, 40.94; of 1925 over 1924, 36.36; of 1926 over 1925, 22.37; and of 1927 over 1926, 15.14 per cent. During the whole period, 1921 to 1927, the amount of lead in the concentrates decreased from 41.87 per cent in 1921 to 41.17 per cent in 1924 but then increased to 48.77 per cent in 1927, a net increase of 6.90 points since 1921. Such an increase indicates that much progress in technology has been attained since 1921, and some further increase may be expected in future as more improved methods are found. At the same time the percentage of lead in the zinc concentrates has gradually decreased from 11.6 per cent in 1921 to 2.46 per cent in 1927.

CANADA

The Canadian mills are likewise treating a large percentage of their ores by selective flotation. The production figures for Canada are shown in the table that follows.

Flotation concentrates produced in Canada, 1924–1927

[Figures compiled by the American Bureau of Metal Statistics]

Year	Lead concentrates			Zinc concentrates				
	Short tons	Lead content		Short tons	Zinc content		Lead content	
		Short tons	Per cent		Short tons	Per cent	Short tons	Per cent
1924	125,879	80,822	64.21	127,901	55,614	43.48	6,920	5.41
1925	161,103	101,908	63.26	168,252	75,454	44.85	6,296	3.74
1926	182,895	118,243	64.65	206,641	93,899	45.44	6,732	3.26
1927	204,754	137,789	67.29	206,867	99,909	48.30	6,074	2.94

Selective flotation in Canada has also materially increased the zinc and lead output as well as the zinc or lead content of the concentrates. The lead content of the zinc concentrates has been gradually reduced from 5.41 per cent in 1924 to 2.94 per cent in 1927. It has been estimated that the Canadian production would be as much as 100,000 tons less if it were not for selective flotation.

MEXICO

Many of the Mexican mines have shown a decrease in tenor of ores with increase in depth. Thus, a good price for lead has been necessary to insure their continued operation. Selective flotation will probably have an increasingly beneficial influence on the Mexican situation. This influence hitherto has been similar in its effects to that in the United States and Canada. The production of zinc by flotation in 1927 was more than three times that in 1925. The lead content is lower than in Canada, and the percentage of recovery of lead is lower. The complexity of the Mexican ores, coupled with the large number of mines producing, has no doubt led to a less favorable recovery. The increased production of 1927 over 1926 is probably largely due to installations using selective flotation.

The following paragraphs are quoted from the American Bureau of Metal Statistics statement of April 23, 1928:

> The returns from 17 operations in this country [Mexico], beginning with 1925, give the following totals:

Flotation concentrates produced in Mexico, 1925–1927

Year	Lead concentrates			Zinc concentrates				
	Short tons	Lead content		Short tons	Zinc content		Lead content	
		Short tons	Per cent		Short tons	Per cent	Short tons	Per cent
1925	108,622	34,308	31.58	85,308	41,693	48.87	2,305	2.70
1926	142,160	61,124	43.00	190,893	96,686	50.65	2,687	1.41
1927	211,107	96,316	45.62	268,160	138,250	51.56	5,327	1.99

> By comparison with the Mexican official statistics it appears that our totals as given above are only a little short of the total zinc production of Mexico.
>
> Most of the zinc concentrate of Mexico is beneficiated pyrometallurgically, principally in Europe, but a small part of its ore is distilled domestically and a part is distilled in bond in the United States. Of the exportation of ore to Europe, a small part goes to electrolytic extraction there.

DOMESTIC PRODUCTION

RÉSUMÉ

Refined primary lead produced in the United States in 1927 from domestic ores amounted to 668,320 short tons, valued (at the average selling price of refined lead, 6.3 cents a pound) at $84,208,000. These figures represent decreases of 1.8 per cent in quantity and 22.7 per cent in value as compared with 1926. Refined lead produced in 1927 from foreign ores and base bullion amounted to 128,210 short tons, valued at $16,155,000. The total output of refined lead in 1927 from both domestic and foreign ores and bullion was 796,530 tons, valued at $100,363,000.

Refined lead produced and consumed in the United States, 1926 and 1927, in short tons

	1926	1927
PRODUCTION		
Domestic desilverized lead	366,413	378,889
Domestic soft lead	258,565	233,944
Domestic desilverized soft lead	55,707	55,487
	680,685	668,320
Foreign desilverized lead	118,256	128,210
Total refined primary lead [1]	798,941	796,530
Antimonial lead	22,524	24,347
Secondary lead [1]	277,300	276,000
CONSUMPTION [2]		
Apparent consumption of primary lead, refinery stocks disregarded	717,653	663,412

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[1] "Primary lead," which is produced directly from ore, is here distinguished from "secondary lead," which is obtained by refining skimmings, drosses, and old metals. The statistics of secondary lead are given on p. 358. In this report the word "lead" used without qualification means primary lead.

[2] For method of calculating consumption see p. 371.

Refined lead produced in the United States from domestic ores, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	539, 905	$76, 667, 000	1923	543, 841	$76, 138, 000
1919	424, 433	44, 990, 000	1924	566, 407	90, 625, 000
1920	476, 849	76, 296, 000	1925	654, 921	113, 956, 000
1921	398, 222	35, 840, 000	1926	680, 685	108, 910, 000
1922	468, 746	51, 562, 000	1927	668, 320	84, 208, 000

QUANTITY AND VALUE OF REFINED LEAD

The total refined lead produced in the United States from 1720 to 1927, from domestic ores and from foreign ores and base bullion, and its value are shown in the following table:

Refined lead produced in the United States, 1720–1927

Year	Short tons							Value	
	Desilverized lead [1] [2]	Desilverized soft lead	Soft lead [2]	Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
1720–1912	7, 176, 497	326, 991	2. 929, 180	10, 432, 668	8, 545, 383	1, 887, 285		....	$924, 600, 000
1913	301, 160	29, 433	131, 867	462, 460	411, 878	13, 223	37, 359	$0. 044	40, 696, 000
1914	340, 397	43, 506	158, 219	542, 122	512, 794	7, 639	21, 689	.039	42, 286, 000
1915	344, 593	44, 001	161, 461	550, 055	507, 026	9, 581	33, 448	.047	51, 705, 000
1916	335, 375	68, 244	167, 515	571, 134	552, 228	6, 085	12, 821	.069	78, 817, 000
1917	365, 998	56, 268	188, 503	610, 769	548, 450	15, 872	46, 447	.086	105, 052, 000
1918	382, 314	47, 418	210, 463	640, 195	539, 905	15, 334	84, 956	.071	90, 908, 000
1919	266, 538	67, 938	147, 744	482, 220	424, 433	7, 656	50, 131	.053	51, 115, 000
1920	273, 135	66, 668	189, 854	529, 657	476, 849	8, 414	44, 394	.080	84, 745, 000
1921	238, 329	52, 747	157, 513	448, 589	398, 222	7, 120	43, 247	.045	40, 373, 000
1922	249, 107	74, 305	209, 250	532, 662	468, 746	13, 898	50, 018	.055	58, 593, 000
1923	366, 241	61, 332	190, 749	618, 322	543, 841	24, 288	50, 193	.070	86, 565, 000
1924	423, 429	63, 449	203, 615	690, 493	566, 407	46, 385	77, 701	.080	110, 479, 000
1925	457, 477	48, 932	260, 560	766, 969	654, 921	47, 024	65, 024	.087	133, 453, 000
1926	484, 669	55, 707	258, 565	798, 941	680, 685	48, 210	70, 046	.080	127, 831, 000
1927	507, 099	55, 487	233, 944	796, 530	668, 320	32, 369	95, 841	.063	100, 363, 000
	12, 512, 358	1, 162, 426	5, 799, 002	19, 473, 786	16, 500, 088	2, 973, 698		....	2, 127, 581, 000

[1] The lead content of antimonial lead is excluded; see page 357.
[2] Desilverized soft lead is excluded.

Details for years prior to 1913 are shown in the annual chapters. The value for years prior to 1917 is based upon the average price in New York; beginning with 1917 the value is based on the total sales of each producing company.

PRODUCTION BY STATES

SMELTER OUTPUT

The smelter production of primary lead in the United States from domestic and foreign sources for 1927 was slightly less than in 1926. While the total output was essentially the same, there was a substantial decrease in the Mississippi Valley States, due partly to curtailments in the production from many of the smaller mines and to a decreased output of by-product lead obtained from zinc mining operations. This decrease was balanced, in part, by an increase in the output of the Western States. The increased application of selective flotation methods applied to the complex western ores increased the output of lead there.

The output of the Mississippi Valley States, including a small production from the Eastern States, amounted to 288,347 short tons in 1927, compared with 313,891 tons in 1926, a decrease of 8.1 per cent. On the other hand, the Western States produced 392,903 tons in 1927, 12,487 tons, or 3.3 per cent, more than in 1926.

These facts summarize the following table, in which the domestic and foreign primary lead output is segregated according to the origin of the ore from which it was obtained. To apportion the production of refined lead according to sources of ore is difficult; lead refiners treat products already smelted whose origin may, as in custom refining, be unknown to them, because the identity of the ore is preserved only as far as the smelter. Accordingly, the following table is compiled, so far as possible, from smelter figures. It includes "pig lead" reported by all smelters running on Mississippi Valley or other "soft" lead ores and "work lead" produced at all other lead smelters, except that the greater part of the product reported by silver-lead smelters operated in conjunction with refineries is stated in terms of refined lead. A like part of the antimonial lead is thus eliminated from the "work lead" produced and appears only in the figures of production of antimonial lead.

Primary lead smelted or refined in the United States, 1918–1927, by sources, in short tons

Source of ore	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Domestic ore:										
Alaska	531	645	591	773	324	400	582	699	1,018	1,010
Arizona	6,195	5,407	5,987	3,313	7,218	8,828	9,372	10,281	10,646	7,918
Arkansas[1]	14	--------	--------	--------	--------	--------	--------	--------	--------	--------
California	6,228	2,004	2,260	614	3,018	5,168	2,305	4,148	4,044	1,232
Colorado	29,395	18,867	17,752	12,104	11,108	23,885	25,491	31,855	37,553	37,040
Idaho	142,640	89,091	117,191	99,707	91,487	127,797	123,709	123,363	132,564	150,618
Illinois[1]	1,010	977	948	271	750	1,286	1,089	474	357	222
Kansas[1]	5,023	7,951	8,421	10,939	10,900	20,207	12,895	15,001	20,884	[2] 7,530
Kentucky[1]	109	83	114	41	73	66	201	96	27	139
Missouri[1]	187,743	150,341	171,999	151,028	202,245	169,323	191,501	208,547	218,083	210,366
Montana	17,586	17,513	13,231	11,565	14,551	18,345	21,226	22,008	26,350	23,041
Nevada	8,726	5,958	8,650	3,553	4,264	8,044	8,070	10,978	11,379	8,680
New Hampshire	--------	16	--------	--------	--------	--------	--------	--------	--------	--------
New Mexico	5,140	1,418	1,123	384	1,230	1,638	2,263	3,782	4,383	8,377
New York	49	--------	--------	--------	--------	--------	--------	--------	--------	--------
Oklahoma[1]	58,755	49,984	68,494	46,902	67,436	59,602	56,017	78,487	70,004	[2] 65,790
Oregon	6	--------	--------	--------	37	47	--------	6	5	2
South Dakota	28	18	6	2	2	--------	2	2	1	79
Tennessee[1]	843	2,371	2,705	--------	751	1,020	985	436	770	19
Texas	30	8	1	1	5	40	27	31	102	275
Utah	76,169	65,102	64,006	51,872	63,130	104,678	119,318	166,844	151,127	155,199
Virginia[1]	59	--------	--------	--------	--------	--------	1,582	2,179	1,714	2,214
Washington	906	1,090	2,460	325	478	2,008	2,057	2,802	2,262	442
Wisconsin[1]	4,275	3,975	3,841	1,079	1,323	601	1,973	2,889	2,052	2,067
Undistributed	59	119	201	101	75	691	15	2	--------	--------
Zinc residues	5,359	4,887	4,366	713	1,284	362	1,320	1,541	505	1,905
	556,878	427,825	494,347	395,287	481,689	551,036	582,000	686,451	695,830	684,165
Foreign ore:										
Africa	1,519	644	1,171	--------	--------	99	6	--------	6	12
Australia	282	69	450	--------	--------	--------	--------	--------	--------	2
Canada	7,550	1,895	1,186	2,877	3,604	3,632	4,633	10,676	5,385	4,138
Central America	--------	12	22	6	14	18	30	6	--------	18
Europe	84	122	19	17	519	139	328	470	233	19
Mexico	4,798	2,261	2,729	1,912	7,260	18,867	33,328	31,107	32,693	22,844
South America	1,101	2,537	2,747	2,235	2,458	1,461	7,663	4,496	9,893	5,506
Other foreign	--------	116	90	73	43	72	397	269	--------	--------

[1] The lead produced by these States is nonargentiferous or soft lead. A small quantity of the lead produced from Colorado and New Mexico ores is also nonargentiferous.

[2] Mine production figures for Kansas are 27,497 short tons and for Oklahoma, 51,680 tons. In view of the great discrepancy between mine and smelter figures for these States, it is reasonable to assume that some Kansas ore was shipped to the smelters from Oklahoma points.

Primary lead smelted or refined in the United States, 1918–1927, by sources, in short tons—Continued

Source of ore	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Foreign base bullion:										
Canada	8,108	567	1,919	1,599	2,900	--------	--------	--------	--------	--------
Mexico	76,809	49,564	42,421	41,648	47,118	50,193	77,701	65,024	70,046	95,841
South America	39	--------	54	--------	--------	--------	--------	--------	--------	--------
	100,290	57,787	52,808	50,367	63,916	74,481	124,086	112,048	118,256	128,380
Grand total	657,168	485,612	547,155	445,654	545,605	628,517	706,086	798,499	814,086	812,545

MINE PRODUCTION

The principal producers among the Western States in 1927 were Utah, Idaho, Colorado, and Montana. Arizona, Nevada, and New Mexico contributed a fair production, and the remainder of the States were less important.

Mine production of recoverable lead, 1918–1927, by States, in short tons

State	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Alaska	564	687	875	759	377	410	631	789	778	1,008
Arizona	5,939	4,847	6,935	3,271	7,535	8,146	9,321	11,938	11,629	9,933
Arkansas	118	27	8	21	42	25	20	58	18	23
California	6,351	1,695	2,407	562	3,156	4,775	2,382	3,283	4,047	1,359
Colorado	32,980	18,535	23,315	9,830	11,739	22,849	23,779	31,483	34,494	33,386
Georgia	--------	--------	2	--------	4	--------	--------	--------	--------	--------
Idaho	139,981	86,612	118,565	99,235	97,917	121,178	124,475	126,521	136,490	151,019
Illinois	2,228	2,063	1,708	672	1,325	1,381	1,464	1,001	655	277
Kansas	7,107	11,057	16,452	18,679	23,271	17,598	18,560	22,775	28,463	27,497
Kentucky	181	84	120	69	92	53	175	152	58	139
Maine	--------	1	--------	--------	--------	--------	--------	--------	--------	--------
Massachusetts	--------	--------	14	--------	--------	--------	(1)	--------	--------	--------
Missouri	190,292	160,024	161,812	180,085	178,412	169,743	189,929	211,566	207,012	198,760
Montana	17,640	16,358	14,846	10,183	14,884	17,973	19,738	18,765	21,153	17,949
Nevada	11,075	7,291	10,100	3,594	4,695	9,078	10,030	12,238	11,184	7,892
New Hampshire	30	--------	--------	--------	--------	--------	--------	--------	--------	--------
New Mexico	4,199	1,443	1,435	339	1,506	1,916	1,817	3,210	3,480	8,026
New York	29	--------	--------	--------	--------	--------	--------	--------	--------	--------
Oklahoma	54,975	52,795	64,086	41,552	62,856	66,904	71,358	79,946	69,704	51,680
Oregon	4	--------	--------	--------	38	14	(2)	3	6	3
Pennsylvania	--------	--------	7	--------	--------	--------	--------	--------	--------	--------
South Dakota	27	16	6	2	--------	--------	--------	--------	--------	69
Tennessee	1,620	2,079	1,880	--------	732	1,250	937	448	800	--------
Texas	13	7	--------	--------	4	13	--------	8	42	244
Utah	79,329	58,819	66,898	44,594	67,666	101,724	116,955	153,335	147,635	151,285
Virginia	774	--------	--------	--------	--------	--------	1,275	2,229	2,450	2,393
Washington	2,504	1,019	2,749	72	691	1,453	1,968	2,814	2,273	478
Wisconsin	4,442	4,130	2,594	972	691	734	1,254	1,877	1,546	2,069
	562,402	429,589	496,814	414,491	477,633	547,217	596,068	684,439	683,917	665,489

[1] It is said that a few tons of lead ore was mined at the old Chipman mine in Massachusetts and was treated at a small smelter owned by the mine operators.

[2] 513 pounds.

Utah.—Utah's production was somewhat larger than in 1926, and practically all of it came from three districts. The most important of these three districts was the Bingham, followed by the Tintic and the Park City. Small outputs were obtained from the Beaver, Ophir, and Little Cottonwood districts.

The principal producing mines in the Bingham district were the United States, Utah-Delaware, Utah-Apex, and Bingham Mines. The Utah-Delaware produced 38,724,000 pounds of lead in 1927, an increase of nearly 7,000,000 pounds over 1926. The Bingham Mines Co. produced 19,034,607 pounds of lead in 1927, including that from lease ore, compared with 15,277,514 pounds in 1926. The Utah-Apex produced 26,506,000 pounds of lead in 1927, a decrease of more than 8,800,000 pounds from production in 1926. The Montana Bingham Co. contributed 346,711 pounds.

At Tintic the main producers were the Tintic Standard Co. and the Chief Consolidated Co. The Tintic Standard Co. produced 43,687,436 pounds of lead in 1927 compared with 47,528,206 pounds in 1926, a decrease of 8 per cent. This company has produced 431,753,878 pounds of lead since it began operations. The Chief Consolidated Co. produced 21,261,426 pounds in 1927 compared with 31,566,687 pounds in 1926, a decrease of 32.6 per cent. The total output of the Chief Consolidated Co.'s mine from 1909 to the end of 1927 has been 231,178,782 pounds of lead. The average value of the lead ore mined in 1927 was $32.98 a ton and of the zinc ore $38.90 a ton.

The Park Utah Consolidated Mines Co. and the Silver King Coalition Mines Co. were the main producers in the Park City district. The Park Utah Co. produced 50,054,168 pounds of lead during 1927, compared with 40,558,913 pounds in 1926. The total production to date has been 620,114,884 pounds of lead, 118,226,576 ounces of silver, 156,716 ounces of gold, 267,523,047 pounds of zinc, and 33,080,801 pounds of copper. The company has paid a total of $34,811,961.55 in dividends since the beginning of its operations. The Silver King Coalition Co. produced 159,654 dry tons of ore having a content of 38,128,833 pounds of lead.

The International Smelting Co.'s smelter near Tooele, Utah, produced 146,073,315 pounds of lead in 1927.

Idaho.—Idaho ranked third in the United States and second among the Western States, with nearly all of its output coming from the Coeur d'Alene region. The principal mines operating in this region in 1927 were the Bunker Hill & Sullivan, the Morning mine of the Federal Mining & Smelting Co., the Hecla, and the Tamarack & Custer. The Callahan Zinc-Lead Co., near Wallace, also made a substantial output.

The Bunker Hill & Sullivan Mining & Concentrating Co. was the largest producer in the Coeur d'Alene region, having an output, including that made by lessees, of 94,971,072 pounds of lead and 1,799,892 ounces of silver. This metal was obtained from 456,134 tons of ore, and the production of metal for 1927 was the largest since the mine opened in 1886, although the output of ore was exceeded in 1916, 1917, and 1926. This company paid $2,993,628.06 in dividends as the result of its 1927 operations, compared with $2,981,709.90 in 1926, bringing its grand total dividends to $39,768,547.74 since the beginning of operations. The reserves of ore blocked out as reported on December 31, 1927, amounted to a little over 3,000,000 tons of average grade ore, a sufficient amount to insure operations for several years at the present rate of production and under present market conditions.

The Morning mine of the Federal Mining & Smelting Co. yielded 398,523 tons of ore averaging 9.4 per cent lead, 4.8 ounces of silver per ton, and 5.7 per cent zinc. In 1926 it yielded 423,881 tons of ore which averaged 9.4 per cent lead, 4.1 ounces of silver per ton, and 5.5 per cent zinc. At the end of 1927 the reserves of developed and probable ore were over 1,700,000 tons, averaging about 9 pe cent lead, 4.5 ounces of silver per ton, and over 5 per cent zinc. This company's Page-Blackhawk mine produced 22,834 tons of ore averaging 6.9 per cent lead, 2.2 ounces of silver per ton, and 2.8 per cent zinc. Its Independence mine in Blaine County yielded 25,706 tons of ore in 1923, averaging 10.2 ounces of silver and 0.035 ounce of gold per ton, and 3.8 per cent lead. This mine is reported as operated by lessees since 1923.

The Hecla Mining Co. produced 60,460,108 pounds of lead and 1,805,135 ounces of silver from company operations in 1927, compared with 57,720,470 pounds of lead and 1,617,257 ounces of silver in 1926. This company paid $1,000,000 in dividends as the result of its successful operations during 1927. It reports a reserve of over 2,500,000 tons of ore, sufficient to maintain operations for at least the next eight years, assuming that present market conditions are maintained. Additional ore, in excess of that mined, was discovered during the year.

The Callahan Zinc-Lead Co. milled 54,698 tons of ore, from which it obtained 5,098 tons of concentrates averaging 53.55 per cent lead and 40.85 ounces of silver per ton, and yielding 5,473,368 pounds of lead and 211,284 ounces of silver.

Colorado.—The mine production of lead in Colorado was 33,386 tons in 1927 compared with 34,494 tons in 1926. The smelter production of primary lead, attributed to Colorado, was 37,040 tons in 1927 compared with 37,553 tons in 1926. Most of this production was obtained from a number of small mines in San Juan County, the Leadville district, and Dolores and San Miguel Counties. The Rico Argentine mine, in the Rico district, promises to develop into a fairly large comparatively low-grade property and may eventually become a large producer.

Montana.—Montana ranked fourth among the Western States in 1927 with a mine production of 17,949 tons compared with 21,153 tons in 1926. The smelter output of primary lead in 1927 was 23,041 tons, compared with 26,350 tons in 1926. The principal producing mines are in the Butte district. Those leading in production in 1927 were the Emma, Butte & Superior, Elm Orlu, Poser, and Silver Dyke. The Angelica mine, in Jefferson County, produced a fairly large tonnage of ore which was shipped to Butte for treatment. The Anaconda Co. produced 20,438,939 pounds of by-product lead from its electrolytic zinc refining operations at Great Falls.

Arizona.—In 1927 the Shattuck Denn and the Copper Queen mining companies continued to lead in the production of lead in Arizona and were followed by the MacNeill mine near Wickenburg, the Aravaipa mine, and the Comstock Silver mine near Kingman. The Mowry mine, near Patagonia, was purchased by the National Lead Co. No notable discoveries were made during the year.

The Phelps Dodge Corporation began operations at its lead smelter at Douglas during August and continued throughout the balance of the year, producing 2,576 ounces of gold, 479,000 ounces of silver, and 4,916,901 pounds of lead. The ores from which this metal was obtained came from mines in Arizona and in northern Mexico. The Copper Queen Branch of the Phelps Dodge Corporation produced 4,031,433 pounds of lead during 1927, and the Shattuck Denn Mining Corporation produced 5,011,837 pounds.

Nevada.—Nevada's mine production decreased from 11,184 tons in 1926 to 7,892 tons in 1927, while the smelter production attributed to the State decreased from 11,379 tons in 1926 to 8,680 tons in 1927. The decrease in output in the State was mainly due to curtailments in some of the larger districts, chiefly because of the lowered price of lead at the end of the year. The main producing mines in 1927 were the San Rafael mine in the Quartz Mountain district, the Bristol Silver mine in the Pioche district, the Richmond-Eureka, Combined Metals, Yellow Pine, Eureka-Holly, and other smaller properties. A new strike, which has not been developed thoroughly to date, was made at the San Rafael mine, which previously had a reserve of 40,000 tons of $25 ore in sight. The ore recently shipped from the new strike averaged about 14.2 per cent lead and 11.3 ounces of silver and $2 in gold per ton. The Alaska Treadwell Co. has developed a fair reserve of intermediate grade ore at Tybo; its plans include the erection of a selective flotation mill in the near future.

New Mexico.—The increased output of New Mexico during 1927 was due principally to the activity of the Pecos mine of the American Metal Co., in San Miguel County. This company operated a 600-ton concentrator employing selective flotation from January 20 throughout the remainder of the year. The ores are complex and averaged about 18 per cent zinc, 4 per cent lead, 1 per cent copper, and 4.5 ounces of silver and $2 in gold per ton. The Organ Mountain, Cook's Peak, Hachita, Hanover, Florida Mountains, Los Cerrillos, Steins, and Kelly-Magdalena districts also produced lead ores.

California.—The production in California decreased materially in 1927, due mainly to the idleness of most of the Inyo County mines during the latter half of the year. The Darwin, Catalina Island, Tecopa, and Mecca mines accounted for most of the output.

Washington and Oregon.—The mine output of lead in Washington during 1927 was 478 tons, compared with 2,273 tons in 1926. The Gladstone mine near Northport in Stevens County, the largest producer in the State in 1926, did not produce in 1927 until October but the company paid regular dividends. Other producers of lead were the Electric Point, near Northport, the Pend Oreille and Grandview mines at Metaline Falls, and the Boundary and Lead Trust properties at Northport. A small production was obtained from Oregon in 1927 as in 1926.

Mississippi Valley States.—The Mississippi Valley States produced 41.8 per cent of the United States smelter production of lead from domestic ores during 1927, compared with 44.75 per cent in 1926 and 44.50 per cent in 1925. Missouri is the principal lead-producing State in the country, and Oklahoma and Kansas ranked second and third, respectively, among the Mississippi Valley States in 1927. Missouri produced 210,366 tons of lead in 1927 compared with 218,083 tons in 1926, a decrease of 3.5 per cent; the State production represented 30.75 per cent of the total output from domestic ores in 1927, compared with 31.34 per cent in 1926. The smelter production of Oklahoma was 65,790 tons in 1927 and 70,004 tons in 1926; mine production totaled 51,680 tons in 1927. The smelter production of Kansas was 7,530 tons in 1927 and 20,884 tons in 1926, and the mine production was 27,497 tons in 1927. From these figures it is apparent that some Kansas ore was shipped to the smelters from

Oklahoma points and credited by the smelters to Oklahoma, although a rechecking of the smelter figures has failed to substantiate this.

The low prices during the latter part of 1927, coupled with an increased supply of refined lead and zinc on hand, affected the output of this region. There are numerous small mines in the Mississippi Valley region, and most of them depend upon good prices to insure a working profit. There were a few consolidations during the year, and it is not unlikely that if present prices are maintained further consolidation will be necessary to keep many of the mines running. The increased production of zinc and lead in the Western States adversely affected the situation in the Mississippi Valley region, largely because zinc, which was previously penalized or thrown on the dumps, is now marketable as a result of selective flotation operation. As much of the lead obtained in the Mississippi Valley region is a by-product of zinc mining operations, a substantial increase in western zinc output would doubtless influence indirectly the lead situation in the Mississippi Valley.

Eastern States.—The most promising development in the Eastern States was in Virginia, where the New Jersey Zinc Co. is developing a large mineralized area.

PRODUCTION BY MAJOR METALLURGICAL ESTABLISHMENTS

Much of the lead produced in the United States is obtained from the mines and smelters of a few large companies whose outputs are not segregated by districts. Among such companies are the American Smelting & Refining Co., the National Lead Co., the United States Smelting, Refining & Mining Co., and the Federal Mining & Smelting Co. The American Smelting & Refining Co. is the largest producer. Its production for 1926 and 1927, including much metal obtained from Mexican ores, is given in the following table.

Metals produced by the American Smelting & Refining Co., 1926 and 1927

	1926	1927
Gold ounces	1,634,158	1,479,899
Silver do	85,482,438	80,671,759
Lead pounds	939,214,000	953,976,000
Zinc do	97,446,000	104,340,000
Copper do	1,051,794,000	1,073,660,000

The Federal Mining & Smelting Co.'s output from all of its mines from 1904 to 1927 has been as follows:

Metals produced by the Federal Mining & Smelting Co., 1927 and 1904–1927

	1927	1904–1927
Ore short tons	1,187,060	18,289,834
Gold ounces	57,738	3,732.8
Silver do	2,187,190	49,615,604
Lead short tons	45,629	957,460
Zinc do	44,310	261,302

The St. Joseph Lead Co.'s output and sales in 1927 were as follows:

Lead produced and sold by the St. Joseph Lead Co. in 1927, in short tons

Ore	4,527,695
Lead concentrates	203,381
Lead content	151,045
Lead:	
Smelter output	140,875
Sales	193,255

Comparable figures for the National Lead Co. and the United States Smelting, Refining & Mining Co. are not available from the company reports.

SOFT LEAD

The lead ores of the Mississippi Valley are almost free from silver, and the lead produced from them is known as soft lead. The output of the lead pigment known as basic lead sulphate or sublimed lead is derived from these ores. The galena of southern Illinois, however, is notably argentiferous as compared with the rest of the Mississippi Valley ores, and the silver-bearing lead concentrates treated during the period 1918 to 1927 averaged 5.5 ounces of silver to the ton; lead in this district is now produced only incidentally in the concentration of fluorspar, and the output is small compared with that from other districts in the Mississippi Valley States. Lead ores from southeastern Missouri also contain a small amount of silver; over a series of years the silver-bearing lead concentrates smelted have averaged about 1 ounce of silver to the ton.

Zinc ores from Western States, that are made into zinc oxide, contain some lead which goes into the pigment; therefore it is not strictly accurate to speak of the lead content of pigments as wholly soft lead.

In some years small quantities of foreign lead have also been made into pigments in the United States. During the period covered by the following table, lead pigments were made from foreign ores in 1924 only, when the lead so recovered amounted to 545 tons.

Soft lead produced in the United States from domestic ores, 1922–1927, in short tons

Year	Soft pig lead			Soft lead recovered in pigments	Total soft lead	Total domestic lead [1]	Soft lead percentage of domestic lead
	Undesilverized	Desilverized	Total				
1922	209, 250	74, 305	283, 555	13, 892	297, 447	488, 448	61
1923	190, 749	61, 332	252, 081	13, 612	265, 693	567, 247	47
1924	203, 615	63, 449	267, 064	15, 338	282, 402	593, 486	48
1925	260, 560	48, 932	309, 492	17, 547	327, 039	684, 968	48
1926	258, 565	55, 707	314, 272	13, 685	327, 957	710, 990	46
1927	233, 944	55, 487	289, 431	13, 136	302, 567	695, 500	44

[1] Includes domestic refined lead, domestic lead in antimonial lead, and domestic lead in pigments.

ANTIMONIAL LEAD

By-product antimonial lead, produced by lead refineries in 1927 from domestic and foreign argentiferous lead ores, amounted to 24,347 short tons. This amount is 8 per cent greater than the production in 1926 and exceeds any previous annual figure. Considerable antimonial lead from secondary sources was also produced at the regular lead smelters in 1927; the figures covering such production are given in the chapter on secondary metals. Much of the ore from which antimonial lead is obtained is produced in the Western States and in Mexico.

By-product antimonial lead produced in the United States, 1918–1927

Year	Total lead refined from base bullion (short tons)	By-product antimonial lead (percentage of total)	Antimonial lead						
			From domestic ore (short tons)	From foreign ore (short tons)	Total				
					Short tons	Value	Antimony content		Lead content by difference (short tons)
							Short tons	Percentage	
1918	382,314	4.9	10,777	7,793	18,570	$2,826,350	2,566	13.8	16,004
1919	266,538	5.2	9,674	4,200	13,874	1,513,968	1,943	14.0	11,931
1920	273,135	4.6	9,604	2,931	12,535	1,963,255	2,033	16.2	10,502
1921	238,329	4.2	7,881	2,183	10,064	870,059	1,589	15.8	8,475
1922	249,107	3.2	7,068	1,007	8,075	844,993	1,441	17.8	6,634
1923	366,241	3.9	11,635	2,555	14,190	1,950,370	2,170	15.3	12,020
1924	423,429	4.9	13,593	7,194	20,787	3,376,713	2,763	13.3	18,024
1925	457,477	4.3	14,472	5,195	19,667	3,785,547	2,624	13.3	17,043
1926	484,669	4.6	18,909	3,615	22,524	3,916,714	2,693	12.0	19,831
1927	507,099	4.8	16,040	8,307	24,347	3,277,043	2,736	11.2	21,611
Average		4.5						13.7	

LEAD PIGMENTS

The amount of lead contained in pigments was equivalent to 38 per cent of the total lead recovered from domestic ores in 1927 and to 37 per cent in 1926. By far the largest part was contained in the pigments manufactured from pig lead—white lead, red lead, orange mineral, and litharge. In these pigments the lead content ranges from about 80 to nearly 93 per cent. A smaller quantity of lead was recovered in the pigment known as basic lead sulphate, or sublimed white lead and sublimed blue lead, and a still smaller amount was recovered from the zinc ores from which the zinc oxides were produced.

Lead in pigments,[1] 1922–1927, by sources, in short tons

Year	Lead in pigments from—			
	Domestic ore	Foreign ore	Primary metal	Secondary metal
1922	13,892		241,096	111
1923	13,612		236,541	
1924	15,338	545	250,930	
1925	17,547		256,064	
1926	13,685		240,902	1,029
1927	13,136		242,713	1,246

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[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.

SECONDARY LEAD

The recovery of lead from waste material is a branch of the metal industry that has expanded notably in recent years. Lead is a relatively cheap metal; but for various reasons, one of which is that it does not rust, it is rather easily reclaimed. The main sources of secondary lead are old pipe, cable sheathings, battery plates, lead linings for acid tanks, and such alloys as babbitt, solder, and type metal. The most important of these sources now is old battery plates which, as stated elsewhere in this chapter, are likely to be returned within two or three years after being fabricated.

Secondary lead recovered in the United States, 1922–1927, in short tons

Year	Pig lead	Lead in alloys	Total recovered lead	Value
1922	75,480	84,080	159,560	$17,552,000
1923	96,430	98,060	194,490	27,229,000
1924	90,400	114,100	204,500	32,720,000
1925	112,420	114,460	226,880	39,477,000
1926	125,000	152,300	277,300	44,368,000
1927	119,000	157,000	276,000	34,776,000

A number of years ago the principal use for lead was in pigments, and lead consumed in this way could not be reclaimed. As time passes the increased tendency toward nondestructive uses is building up a large reserve of lead which will eventually become available for reuse. The quantity of secondary lead recovered in the United States has increased largely not only in actual tonnage but also relatively in respect to the primary production of lead. As the following table indicates, the ratio of secondary lead recovery to refined primary lead production in the United States has been increasing quite rapidly since 1918, amounting in 1927 to 41 per cent.

Ratio of secondary lead recovered to refined primary lead produced in the United States from domestic ores, 1913–1927

Year	Refined primary lead		Secondary lead	
	Short tons	Average price per pound (cents)	Short tons	Ratio to refined primary lead (per cent)
1913	411,878	4.4	72,834	18
1914	512,794	3.9	61,062	12
1915	507,026	4.7	78,900	16
1916	552,228	6.9	96,300	17
1917	548,450	8.6	93,500	17
1918	539,905	7.1	97,100	18
1919	424,433	5.3	122,100	29
1920	476,849	8.0	124,650	26
1921	398,222	4.5	103,780	26
1922	468,746	5.5	159,560	34
1923	543,841	7.0	194,490	36
1924	566,407	8.0	204,500	36
1925	654,921	8.7	226,880	35
1926	680,685	8.0	277,300	41
1927	668,320	6.3	276,000	41

LEAD SMELTERS AND REFINERIES

UNITED STATES

Arizona: Douglas—Phelps Dodge Corporation. (Smelter.)
California: Selby—Selby plant, American Smelting & Refining Co. (Smelter and refinery.)
Colorado:
    Durango—Durango plant, American Smelting & Refining Co. (Smelter.)
    Leadville—Arkansas Valley plant, American Smelting & Refining Co. (Smelter.)
Idaho: Kellogg—Bunker Hill & Sullivan smelter. (Smelter and refinery.)
Illinois:
    Chicago—Great Western Smelting & Refining Co.[2] (Smelter.)
    Collinsville—St. Louis Smelting & Refining Works of National Lead Co. (Smelter and refinery.)
    Federal—Federal plant, American Smelting & Refining Co. (Smelter.)
Indiana:
    East Chicago—International Lead Refining Co.[3] (Refinery only.)
    East Chicago—U. S. S. Lead Refinery (Inc.).[4] (Refinery only. Betts electrolytic process.)
Kansas: Galena—Galena plant, Eagle-Picher Lead Co. (Smelter.)
Missouri:
    Granby—American Zinc, Lead & Smelting Co.[5] (Smelter.)
    Herculaneum—St. Joseph Lead Co. (Smelter and refinery.)
    Joplin—Eagle-Picher Lead Co. (Smelter.)
Montana: East Helena—East Helena plant, American Smelting & Refining Co. (Smelter.)
Nebraska: Omaha—Omaha plant, American Smelting & Refining Co. (Refinery only. Betts electrolytic process.)
New Jersey:
    Newark—Balbach plant, Balbach Metals Corporation. (Smelter and refinery.)
    Perth Amboy—Perth Amboy plant, American Smelting & Refining Co. (Smelter and refinery.)
Oklahoma: St Louis—Ontario smelter, Eagle-Picher Lead Co. (Smelter.)
Pennsylvania: Carnegie—Pennsylvania Smelting Co. (Smelter and refinery.)
Texas: El Paso—Kansas City Consolidated Smelting & Refining Co.[6] (Smelter.)
Utah:
    International—International Smelting Co.[3] (Smelter.)
    Midvale—United States Smelting, Refining & Mining Co. (Smelter.)
    Murray—Murray plant, American Smelting & Refining Co. (Smelter.)

CANADA

British Columbia: Trail—Consolidated Mining & Smelting Co. of Canada (Ltd.). (Smelter and refinery. Betts electrolytic process.)
Ontario: Galetta—Kingdon Mining, Smelting & Manufacturing Co. (Ltd.). (Smelter.)

MEXICO

Chihuahua: Chihuahua—American Smelting & Refining Co. (Smelter.)
Coahuila: Torreon—American Metal Co. (Ltd.). (Cia. Metalúrgica de Torreon.) (Smelter.)
Nuevo Leon:
    Monterrey—American Metal Co. (Ltd.). (Cia. Minera de Peñoles—S. A.) (Smelter and refinery.)
    Monterrey—American Smelting & Refining Co. (Smelter.)

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[2] Smelters of secondary materials but treating some lead ores.
[3] Subsidiary of Anaconda Copper Mining Co.
[4] Subsidiary of the United States Smelting, Refining & Mining Co.
[5] Plant idle in 1927.
[6] Subsidiary of American Smelting & Refining Co.

San Luis Potosi: San Luis Potosi—American Smelting & Refining Co. (Cia. Minera Asarco.) (Smelter.)

Zacatecas: La Fé—American Metal Co. (Ltd.). (Cia. Minera de Peñoles—S. A.) (Smelter.)

WORLD PRODUCTION

The accompanying table shows the world smelter production of lead from 1923 to 1927, so far as statistics are available. Official figures are used wherever possible. For countries for which official data are not yet available the figures are taken from the yearbook of the American Bureau of Metal Statistics and other reliable sources, but in later reports the official statistics will be substituted as received.

There is always a possibility of duplication in figures showing world production, for some countries send "work lead" or base bullion to other countries for refining. Furthermore, secondary and antimonial lead are often included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary lead and antimonial lead. The figures for the United States represent refined lead that was smelted in this country, whatever the source of the ore.

World production of lead, 1923–1927, in metric tons[1]

[Compiled by L. M. Jones, of the Bureau of Mines]

Country[2]	1923	1924	1925	1926	1927
Australia	132, 165	130, 494	151, 269	155, 398	167, 616
Austria	4, 255	4, 985	5, 408	6, 478	8, 086
Belgium	65, 680	77, 950	87, 480	87, 876	(3)
Canada	46, 801	75, 503	104, 303	123, 644	135, 854
Chosen	(4)	(4)	485	1, 958	(3)
Czechoslovakia	2, 452	2, 264	2, 212	2, 316	2, 394
France	17, 413	18, 881	20, 543	19, 500	24, 900
Germany	56, 110	67, 427	89, 458	96, 200	[5] 81, 800
Great Britain	6, 815	5, 387	4, 811	4, 334	6, 132
Greece	4, 235	5, 106	5, 366	5, 059	4, 800
India (Burma)	46, 799	52, 590	48, 034	55, 202	67, 027
Italy	17, 131	22, 062	24, 475	23, 590	23, 774
Japan	2, 700	2, 941	3, 337	3, 610	4, 000
Mexico	150, 028	133, 440	163, 236	170, 723	227, 870
Northern Rhodesia	11, 197	5, 999	3, 406	3, 897	6, 042
Norway	242	642	406	385	(3)
Poland	17, 195	20, 223	28, 631	27, 924	28, 863
Rumania	402	433	489	655	828
Russia[6]	307	685	1, 021	1, 342	1, 850
South America	5, 081	11, 703	11, 964	17, 663	14, 604
Southwest African Protectorate[7]	622	813	1, 619	1, 682	3, 898
Spain	127, 514	141, 849	153, 567	149, 514	144, 023
Sweden	119	477	723	522	330
Tunisia	14, 090	14, 291	16, 013	18, 106	10, 662
Turkey	1, 400	5, 104	4, 786	6, 014	7, 852
Union of South Africa	5, 099	4, 609			
United States (refined)	515, 395	555, 913	636, 790	661, 239	635, 651
Yugoslavia	9, 260	11, 487	10, 956	9, 809	3, 185
Known production	1, 261, 000	1, 373, 000	1, 581, 000	1, 655, 000	1, 703, 000

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[1] By countries where smelted but not necessarily refined.

[2] In addition to the countries listed, China smelts lead, but no reliable data of output are available. Official estimates of production in 1925 range from 1,500 to 3,500 tons. Indo-China, also, reported 1 ton of lead smelted in 1926, and 4 tons in 1927.

[3] Estimate included in total.

[4] Data not available.

[5] Exclusive of Upper Silesia.

[6] Data for year ended Sept. 30.

[7] Data for year ended Mar. 31 of year following that stated.

SUMMARY OF PRODUCTION AND CONDITIONS IN PRINCIPAL LEAD-PRODUCING REGIONS OF THE WORLD

Despite its slight decrease in production from that of 1926 the United States remained in first position as a lead-producing country in 1927. In Spain and in a few of the less important producing countries production also decreased in 1927, but the lead output of the world as a whole showed an increase as compared with 1926. Mexico retained second place in 1927 and was followed in order by Australia, Spain, Canada, Germany, India, and Belgium. The decrease in Spain was due mainly to the lowering price of lead, and a serious situation was partly prevented by Government aid. While Australia increased production through further improvements in metallurgical efficiency, that Commonwealth is still confronted with labor difficulties which again threaten a shutdown of some of the properties in the Broken Hill district unless the price of lead rises substantially. The entry of the Anaconda Co. into Upper Silesia was to no little extent responsible for the increased production there. This company is now the main producer in Polish Silesia. Italian producers were forced to curtail output somewhat near the end of the year, a condition brought about by a decided drop in the price of lead, coupled with an improvement in the value of the lira. Belgium and France both report a substantial production of refined lead, but the ores from which it is obtained are imported from Italy, Africa, Mexico, and Greece. France, however, produces some ores in the departments of Gard and Lozère. Relatively small tonnages were obtained from mines in Argentina, Chile, Russia, China, Greece, Turkey, and Rhodesia.

MEXICO

Mexico, even with the decreased price of lead and partial exhaustion of some of the mines, showed an increased production—namely, 227,870 metric tons of lead in 1927 compared with 170,723 tons in 1926, an increase of 33.5 per cent. Many of the mines are facing exhaustion of the bonanza ores and will in consequence have to work the complex sulphides that usually underlie the richer oxidized ore. This means that more effective mining and metallurgical methods must be adopted.

By far the greater proportion of the lead ores mined in Mexico come from limestone replacement deposits known as "mantas." The great manta deposits of Santa Eulalia, Mapimi, Naica, and Sierra Mojada continued their outputs, as did a number of the smaller mantas. The great lead region, comprising parts of southern Chihuahua, western Coahuila, Durango, and eastern Sonora, shows reserves sufficient for a few years ahead, even though manta deposits are very hard to estimate accurately. The mantas, which usually contain oxide ores, generally branch from a central chimney or a group of chimneys, in which the ores are complex sulphides of silver, lead, zinc, antimony, copper, and free gold. Both ordinary and selective flotation are rapidly gaining a foothold, and since these methods are decidedly applicable to the ores it is to be expected that Mexico's production can be maintained at a comparatively low cost and under reasonably low market conditions. Selective flotation is probably responsible for the added production during 1927; it has been estimated that over 30 per cent of this production was beneficiated by selective flotation. In view of the trend toward this method it is safe to say that a continued larger output of flotation concentrates is to be expected for a few years. (See pp. 347 and 348.)

CANADA

Canada's production for 1927 was 135,854 metric tons, compared with 123,644 tons in 1926, an increase of 10 per cent. By far the greater portion of this production came from the great Sullivan mine of the Consolidated Mining & Smelting Co. of Canada (Ltd.) in British Columbia. The remaining producing districts of importance include the Galetta (Ontario), Mayo (Yukon Territory), and the Tetreault (Quebec) districts.

The Consolidated Mining & Smelting Co. handled 1,405,872 tons of ore at its Kimberley and Tadanac plants, the concentrates from which were shipped to its smelter at Trail. This smelter treated custom ores and concentrates amounting to 135,454 tons, most of which came from the Slocan-Ainsworth-Lordeau, Boundary, Nelson-Arrow Lakes, and East Kootenay districts. The Trail smelter handled 547,682 tons of ores and concentrates from all sources, and it produced 145,522 tons of lead, 73,527 tons of zinc, 9,261 tons of copper, 7,179,607 ounces of silver, and 29,490 ounces of gold. During 1926, 131,053 tons of lead, 67,546 tons of zinc, 10,632 tons of copper, 7,178,817 ounces of silver, and 50,075 ounces of gold were produced. The Consolidated Mining & Smelting Co. handled practically all of the output of lead, silver, and zinc ores from British Columbia, and the development of the Sullivan mine is one of the outstanding features in recent years; at the end of 1927 it was producing about 4,000 tons of ore daily. Selective flotation and electrolytic methods for zinc production have greatly aided this enterprise.

The Tetreault district produced 130,800 tons of ore from which were obtained 21,400 tons of zinc concentrates and 7,890 tons of lead concentrates. The mill handles daily 450 tons of ore averaging for the year 1927 9 per cent zinc, 3 per cent lead, and 8 ounces silver and 0.1 ounce gold a ton.

The Alaska-Treadwell Co., at its Errington mine in British Columbia, is said to have developed a million tons of low-grade ore averaging 5.74 per cent zinc, 1.33 per cent lead, 1.33 per cent copper, 2.15 ounces of silver, and 0.021 ounce of gold. The 200-ton selective flotation plant being built will probably be completed during 1928.

NEWFOUNDLAND

A new lead field, opened in the Placentia Bay region in Newfoundland, promises to furnish several thousand tons of lead a year. It did not produce on a large scale in 1927, but an increased production may be expected for 1928. The La Manche mine is now equipped with a 100-ton concentrator, which is expected to be in operation during 1928. There are a number of prospects, some of which may develop into good mines. The Swedish Electrical Prospecting Co. is said to have located 3,000,000 tons of ore averaging about 17 per cent zinc, 17 per cent lead, 2 per cent copper, and 5 ounces of silver. The value of these deposits (in which American capital is said to be interested) is estimated at $30,000,000. The development of this field has aroused wide interest, particularly on account of successful use of electrical methods of prospecting by which ore bodies have been located.

AUSTRALIA

The production of lead in Australia increased from 155,398 metric tons in 1926 to 167,616 tons in 1927, the increase being mainly attributed to increased efficiency in mining and metallurgical methods.

The production comes mainly from three districts, the most important of which is Broken Hill in New South Wales. Labor troubles again appear to be causing a critical situation, a condition that is being aggravated by the low price of lead. The following comment[7] explains the situation there:

> In addressing the general meeting of share-holders in the Broken Hill Proprietary Co., Ltd., at Melbourne, last week the chairman, H. G. Darling, dealt at some length with the causes which had rendered the company's mining operations unprofitable, and which threatened to put an end to its activities. The point had been reached, he said, not only in mining, but in other industries also, where it was cheaper to cease operations and bear all overhead charges, than to continue full working at heavy losses. While the low price of metals was one of the chief factors responsible for the present unhappy situation, the direct and indirect costs were very heavy. The reduction in the working hours underground from 44 to 35 resulted in a reduction of the effective hours from 35 to 20 a week, with a corresponding reduction in output, but the most serious aspect of the hours' problem at Broken Hill was the reduction from three to two shifts daily, involving a cut in production of 50 per cent. But for this reduction, costs would have been lowered enabling ore to be worked which it would be uneconomic to handle under the existing circumstances. The ore supply available and economically treatable would, too, have been augmented, and valuable products recovered, which under present conditions was impossible except at a loss.
>
> Improved appliances and methods had, said the chairman, been introduced from time to time, which, concurrently with high metal prices tended to mitigate the effect of adverse labor conditions. These same improvements, however, with three shifts a day and 44 hours a week underground would have enabled still lower-grade ore to be worked, giving increased employment and further increasing the output of valuable products. Indirect costs had been put up recently by legislative Acts, including Child Endowment. This, plus the Workmen's Compensation legislation had worsened the position to the extent of 36,000 pounds sterling per annum for the Broken Hill mine alone.

Much of the advance made in lowering costs with the application of newer and more efficient mining and metallurgical methods was counteracted by the labor situation in all of the mines. Selective flotation increased the output somewhat, and it is estimated that the zinc production has increased from 2,000 tons in 1918 to 53,000 tons in 1926. It is believed that many of the mines will be forced to close down for a time until there is a substantial increase in the price of lead or costs can be reduced. The Broken Hill district produced 1,394,926 long tons of ore in 1927 which averaged around 10 to 15 per cent lead, 9 to 14 per cent zinc, and 2.5 to 5 ounces of silver. It is reported that Broken Hill has at least 8 to 10 years of life but that its reserves will likely average slightly less than the ore mined in 1927, and under present conditions are barely at the economic limit.

The outstanding development of the year was in the Mount Isa district, Queensland, where 4,000,000 to 4,500,000 tons of lead ores averaging 7 to 12 per cent lead, 9 to 14 per cent zinc, and 4 to 6 ounces of silver are said to have been proven. Development work has been carried to a depth of 300 to 350 feet in several places, and the results obtained here have been supplemented by diamond drilling. The plans of the producers call for a production of several thousand tons of refined lead, and it has been stated that the smelting plant will have a capacity of 56,000 tons of lead bullion per annum, starting early in 1929.

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[7] Metal Bulletin, Sept. 2, 1927.

The Russo-Asiatic Consolidated (Ltd.) entered the Mount Isa field and appears to have made quite satisfactory progress as indicated by the following quotation from the account[8] of this company's meeting in July, 1927:

> As to the present magnitude and future promise of this great mining property, there can be no doubt. Underground development work to an average vertical depth of 200 ft. as at Dec. 31, 1926, had reasonably proven about 4,000,000 tons of carbonate ores, and the promise held out by these developments has been confirmed by the results of the first diamond drill holes, completed into the sulphide zone on only two of the several existing orebodies. On the Rio Grande, at an approximate depth of 400 ft. about 40 ft. of sulphide ore was cut, assaying some 17 per cent lead and 19 ozs. silver per ton, while a second borehole on the Black Star orebody at also about the same depth cut sulphide ore as follows: 39 ft. assaying 10 per cent lead, 14.3 per cent zinc, 5.3 ozs. silver, followed by 115 ft. assaying 5.8 per cent lead, 9.7 per cent zinc, 3.7 ozs. silver, followed by 10 ft. assaying 7.0 per cent lead, 12.6 per cent zinc, 5 ozs. silver, followed by 35 ft. assaying, 7.7 per cent lead, 11.4 per cent zinc, 5.3 ozs. silver, representing a horizontal width of 183 ft.

The Mugwana district is reported to have comparatively low grade reserves, amounting to about 40,000 tons of ore. The Russo-Asiatic Consolidated (Ltd.) controls the most promising mines in this district.

INDIA

India (Burma) produced 67,027 metric tons of refined lead in 1927, compared with 55,202 tons in 1926, an increase of 21.42 per cent. Practically all of the production comes from the Bawdwin mines of the Burma Corporation in the Upper Shan States; these appear to cover the largest high-grade lead deposit in the world, having developed ore reserves of over 4,100,000 tons, averaging 26.2 per cent lead, 16.6 per cent zinc, and 22.4 ounces of silver per ton. The production of this company for the years ended June 30, 1926 and 1927, was as follows:

Metals produced by the Burma Corporation in years ended June 30, 1926 and 1927

Product	1926	1927
Lead, refined ... long tons	51,270	56,791
Antimonial lead ... do	719	782
Copper matte ... do	9,869	12,141
Zinc concentrates[1] ... do	33,643	54,287
Silver, refined ... ounces	5,236,730	5,108,103

[1] Concentrates average 46.45 per cent zinc, 13.06 ounces of silver, and 7.14 per cent lead.

This mine gives promise of continuing its present high production for some years, and the management is confident that with further development the ore reserves can be increased or held about the same for some time. Some notable advances were made in metallurgical practice during the year, and a more satisfactory recovery was reported.

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[8] Report of Russo-Asiatic Consolidated (Ltd.) to stockholders, July 1, 1927.

SPAIN

The production in Spain was 144,023 metric tons of lead in 1927, compared with 149,514 tons in 1926, a decrease brought about by the materially lowered prices and the erratic character of many of the deposits. Many of them were worked on very narrow, irregular stringers of galena. Early in 1927 a crisis arose, and in consequence the Government subsidized the smaller producers and combined a number of them into two syndicates, one composed of the producers of the Linares region and the other a group of companies in the Cartagenian region. The Government proposes further to erect new smelters or to recommission old ones for the treatment of the syndicate ores. It proposes to loan sums of money, the total of which is not to exceed 3,000,000 pesetas, to cover the difference between production costs and selling prices. The essential legal features are summarized in the Mining Journal (London) of July 9, 1927, as follows:

> The main idea consists of syndicating the mines, and the general outlines proposed are as follows:
>
> In every one of the mining regions into which Spain has been divided a syndicate of mine owners may be formed. Such are being arranged in Linares and in Cartagena.
>
> During the year from July 1, 1927, to June 30, 1928, the State will advance to every mine embraced in the syndicate a sum to cover the difference between production and selling cost, but the maximum liability of the State will not exceed 3,000,000 pts. The cost of production must not exceed 800 pts. per ton of lead and 100 pts. per kilo of silver, which is always present in Spanish ores.
>
> As galena and blende are often associated in Spanish lead mines, especially in the Eastern region, a minimum value has been fixed for blende on the following scale: For blendes containing less than 30 per cent zinc the standard is 20 per cent blende, with a value of 43 pts. per tonne, rising or falling 4 pts. per unit.
>
> For blendes above 30 per cent zinc the standard will be 30 per cent ore, rising or falling 5 pts. per unit.
>
> The selling price of the metal will be fixed each month by a mixed commission of the syndicate and State engineers.
>
> The cost of the output for each mine will be similarly fixed and the owners will have a right to be heard.

The money is loaned not only to cover mining and marketing expenses but also to place the companies on a more modern basis by retiring the old methods of mining and milling in favor of those that are newer and more efficient, as the methods now in vogue are in many cases obsolete. A number of old smelters can be remodeled and thus made available for handling the syndicate products. The principal opposition to this plan thus far has come from the larger smelting plants, which do not favor the establishment of new smelting works. Selective flotation methods are gradually being adopted by the Spanish mines.

FRANCE

The Russo-Asiatic Consolidated (Ltd.), after unsuccessful attempts to regain its concessions in Russia, has purchased an interest in the Villemagne lead-silver-zinc mines in southern France, also the controlling interest in the Mines de St. Sebastian d'Algrefeuille zinc-lead property. These properties are said to contain reserves of some magnitude. The Vieille Montagne mines produced 17,306 short tons of lead in 1927 against 16,975 tons in 1926.[9]

ITALY

Italy produced 23,774 metric tons in 1927, compared with 23,590 tons in 1926. Much of the lead production of Italy is shipped as galena or concentrates to smelters in France and Belgium. In Italy, as in the other countries of Europe, the price of lead and zinc has adversely affected the situation. Within the past year the price of zinc dropped about 10 pounds sterling per metric ton, and at the same time the lira increased materially in value. These factors, coupled with the higher deductions demanded by the smelters, have made the position of the zinc miners unstable. As a result wages were reduced about 10 per cent, and increased unemployment was brought about through curtailment of work at some of the mines. There was a similar drop in the price of lead during the past year, but as the smelters did not increase their rates on lead ores the lead miners were slightly better off than the zinc miners. At lead-zinc mines where the lead is obtained as a by-product the situation is naturally somewhat worse, and suspension of operations is threatened. Until such time as the prices of lead and zinc rise only the large companies are able to continue operations.

ARGENTINA

The National Lead Co. has been developing the Pumahuasi mines in northern Argentina, and the concentrates from its mills are being shipped to a smelter near Buenos Aires, 600 miles south of the mines. This smelter has a capacity of 250 tons of pig lead a month. Other lead-producing districts include San Rafael, Province of Mendoza, and the Capelletas mine, Province of Cajamarca. Many of the mines are fairly inaccessible, and while they are potential producers they can not operate under present market conditions at a reasonable profit.

RHODESIA

The Chamber of Mines gives a total for Northern Rhodesia of 6,661 short tons of lead in 1927. The Broken-Hill Rhodesia Corporation (Ltd.) produces practically all of the lead obtained in Northern Rhodesia. This company reports its reserves up to December 31, 1926, as follows:

Kind of ore	Long tons	Grade		
		Lead	Zinc	V_2O_5
		Per cent	*Per cent*	*Per cent*
Zinc oxide	935,000	8	30	9
Vanadium oxide	38,000	--------	8	3.5
Sulphides	164,000	20	39	--------
Tailings	204,500	--------	4.2	1.2

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[9] Year Book of the American Bureau of Metal Statistics, 1927, p. 46.

RUSSIA

Among the important producing lead-zinc deposits of Russia are those of the Sadonski, Elbrus, and Kazakstan districts, the Turlansk district in Turkestan, the Suleiman Sai, Tabarsharsky, Tereklisaiski, Mansyrski, and Kansaisk districts in western Siberia, and the Kadainska, Primorsk, and Chitinsk districts in eastern Siberia. The production for 1927 was 1,850 metric tons. The developed reserves of these districts, as estimated by the geological committee of the Soviet Government, probably do not aggregate more than 250,000 metric tons of metallic lead content. Other important mines operating at present are located in the eastern Kirghiz steppes and in the Arpa Valley in Armenia. These Russian Armenian deposits are said to contain about 500,000 metric tons of metallic lead in ores running from 5 to 10 per cent lead. The eastern Kirghiz steppes have 13 areas from which ore is obtained, and the estimated reserve is quoted at about 3,300,000 metric tons of ore, containing 225,000 to 265,000 metric tons of metals of which 160,000 tons is metallic lead.

UPPER SILESIA

The zinc-lead field in Upper Silesia covers a part of Czechoslovakia, Poland, and Germany. The Polish and Czechoslovakian portions are practically controlled by the Anaconda Copper Mining Co., whose activities have brought about the maintenance of productions in the region. This company entered the field in 1925. According to the figures of the American Bureau of Metal Statistics the production of Upper Silesia in 1927 was 28,884 metric tons of lead compared with 27,804 tons in 1926. The international difficulties encountered shortly after the World War have apparently been overcome, and a steady production may be expected for some time in the future. This field, like the Mississippi Valley region in the United States, is primarily a zinc-producing region, but a large output of lead is made as a by-product of the zinc-mining operation. Poland had an output of 28,863 metric tons in 1927 compared with 27,924 tons in 1926, practically all of which came from the Upper Silesia field

TUNISIA

The output of lead for 1927 in Tunisia was 10,662 metric tons, compared with 18,106 tons in 1926. The principal producing mines are the Société Belge des Mines Réunies and the Djebel Hallouf mines; but much of Tunisia's production is obtained from numerous small scattered deposits.

BELGIUM

Belgium produced 65,501 metric tons of refined lead in 1927, compared with 61,700 tons in 1926, practically all of which was obtained from foreign ores, bullion, and concentrates. Much of this was obtained from Mexico, Africa, and southern Europe. A small tonnage of lead ore is obtained from the mines of the Vieille Montagne Co.

In addition to the refined lead noted above there was some work lead produced that was not refined in this country.

IMPORTS AND EXPORTS

The total (general) imports of lead into the United States in ore, base bullion, and as refined lead in 1927 were greater than in any previous year; they amounted to 161,389 short tons, or slightly less than one-fourth of the refined lead produced from domestic ore. About 93 per cent of this imported lead came from Mexico. Some of the imported lead ores, etc., are later exported as pig lead or manufactured products to foreign countries. The United States consumed less foreign lead in 1927 than in 1926, as there was a larger percentage exported in 1927 than during the previous year. A description of the difference between general imports and imports for consumption and the method of warehouse transactions is given in Mineral Resources, Part I, 1919, page 324.

Exports of refined lead from domestic ore virtually began in 1914, when the price of lead at London rose above that at New York, and amounted to 58,722 short tons; in 1916 exports reached 100,500 tons, but they declined immediately and for the years 1920 to 1927 averaged 3,659 tons annually. The quantity exported in 1927 was 2,533 tons, of which 53 per cent went to South America. The exports of refined lead from foreign ore are much larger than those from domestic ore and in 1927 amounted to 122,734 tons, an increase of 81 per cent over 1926, when 67,660 tons were exported. This increase is no doubt brought about by increases in production in Mexico and Canada. Much of the lead in ore and in other materials that is brought into this country from Mexico and Canada after smelting or refining in bonded establishments is reexported to England, Belgium, Germany, and France.

Lead remaining in warehouse in the United States, December 31, 1918–1927, in pounds

[Stated in the form in which the material was entered for warehouse]

Year	Ore	Base bullion	Pigs, bars, and old	Year	Ore	Base bullion	Pigs, bars, and old
1918	12,805,167	21,192,655	944,483	1923	76,031,259	80,306,856	5,234,475
1919	29,543,811	61,408,873	468,154	1924	103,474,370	95,007,016	10,090,668
1920	32,923,299	69,517,026	2,644,576	1925	105,884,711	91,725,008	[1] 16,565.672
1921	13,679,465	24,692,350	693,440	1926	114,630,697	107,582,653	[1] 21,820,057
1922	10,470,144	7,076,544	------------	1927	99,526,339	126,669,674	[1] 19,326,011

[1] Includes lead in reclaimed scrap, as follows: 1925, 241,078 pounds; 1926, 397,433 pounds; 1927, 397,712 pounds. Corresponding figures for earlier years are not recorded separately.

Lead imported for consumption in the United States, 1918–1927, by classes

Year	Lead in ore [1]		Lead in base bullion		Pigs, bars, and old [2]		Sheets, pipe, and shot		Not otherwise specified	Total value
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value		
1918	6,064,902	$344,080	3,559,071	$180,070	1,139,950	$56,694	6,892	$624	$36,723	$618,191
1919	4,106,823	196,363	31,796,693	1,130,937	10,174,115	415,094	8,018	628	17,187	1,760,209
1920	13,700,499	908,619	66,816,820	3,340,600	68,901,959	3,887,821	81,396	5,483	21,328	8,163,851
1921	6,842,807	327,046	56,819,980	1,668,410	61,909,094	1,972,716	3,087	140	11,204	3,979,516
1922	23,649,851	812,603	55,859,422	1,815,142	8,563,110	335,924	6,018	697	12,286	2,976,652
1923	22,420,046	1,190,414	11,124,151	626,201	42,925,265	2,510,466	19,525	4,495	90,027	4,421,603
1924	65,147,976	3,145,791	28,796,402	1,542,167	27,362.392	1,850,862	11,666	4,384	138,637	6,681,841
1925	12,706,508	672,112	24,747,665	1,823,566	15,464,205	1,038,350	27,579	10,429	139,533	3,683,990
1926	58,752,911	3,393,039	13,341,038	972,758	24,365,570	2,191,658	864,342	101,322	62,895	6,721,672
1927	70,260,478	4,203,897	14,629,606	925,328	9,933,679	635,807	988,170	104,890	52,626	5,922,548

[1] Includes also lead in matte beginning Sept. 22, 1922.

[2] Includes also imports of antimonial lead, antimonial scrap lead, babbitt metal, solder, etc., beginning ith tariff of Sept. 22. 1922 ,except in 1925, 1926, and 1927, when antimonial lead is excluded.

Lead imported into the United States, in ore, base bullion, and refined, 1918–1927, by sources, in pounds

[General imports]

Year	Canada	Mexico	South America	Europe	Other countries	Total
1918	28, 225, 878	162, 259, 199	1, 962, 124	62, 510	4, 705, 049	197, 214, 760
1919	10, 391, 115	125, 541, 614	5, 504, 416	89, 840	286, 142	141, 813, 127
1920	8, 199, 234	131, 815, 278	7, 085, 351	38, 766, 504	11, 163, 160	197, 029, 527
1921	8, 127, 158	106, 406, 238	2, 381, 365	30, 224, 701	1, 430, 949	148, 570, 411
1922	8, 663, 236	141, 216, 136	3, 803, 478	1, 454, 384	513, 335	155, 650, 569
1923	11, 399, 671	242, 352, 788	5, 300, 161	11, 004, 938	520, 635	270, 578, 193
1924	11, 022, 091	243, 161, 069	15, 820, 867	4, 857, 805	453, 432	275, 315, 264
1925	11, 646, 820	218, 873, 800	10, 621, 737	1, 594, 963	1, 521, 110	244, 258, 430
1926	12, 316, 740	254, 203, 852	24, 790, 075	3, 224, 504	572, 856	295, 108, 027
1927	6, 214, 867	300, 634, 815	14, 583, 513	1, 226, 049	118, 883	322, 778, 127

Lead imported into the United States, 1918–1927, by classes, in pounds

[General imports]

Year	Lead in ore	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1918	37, 070, 340	149, 663, 889	10, 480, 531	197, 214, 760
1919	19, 573, 856	112, 024, 518	10, 214, 753	141, 813, 127
1920	29, 488, 816	96, 103, 603	71, 437, 108	197, 029, 527
1921	14, 234, 039	71, 733, 838	62, 602, 534	148, 570, 411
1922	24, 474, 481	124, 074, 465	7, 101, 623	155, 650, 569
1923	66, 882, 850	161, 496, 495	42, 198, 848	270, 578, 193
1924	95, 320, 168	155, 501, 350	24, 493, 746	275, 315, 264
1925	88, 962, 502	141, 253, 559	14, 042, 369	244, 258, 430
1926	116, 232, 669	156, 570, 738	22, 304, 620	295, 108, 027
1927	81, 276, 126	236, 567, 252	4, 934, 749	322, 778, 127

Type metal imported for consumption in the United States, 1918–1927

Year	Type metal		Lead content	
	Pounds	Value	Pounds	Percentage
1918	551, 794	$35, 938	513, 166	93. 0
1919	13, 394, 803	816, 642	11, 000, 498	82. 1
1920	29, 887, 353	1, 349, 495	25, 761, 543	86. 2
1921	38, 971, 351	1, 191, 553	30, 706, 845	78. 8
1922	44, 895, 120	1, 120, 814	33, 944, 199	75. 6
1923	(1)	(1)	7, 353, 463	(1)
1924	(1)	(1)	1, 288, 766	(1)
1925	[2] 6, 009, 161	463, 134	4, 309, 549	71. 7
1926	[2] 8, 621, 175	912, 331	7, 053, 849	81. 8
1927	[2] 878, 346	65, 049	666, 654	75. 9

[1] Figures not available.

[2] Includes antimonial lead.

Refined lead, from domestic ores, exported from the United States, 1918–1927

Year	Short tons	Value	Year	Short tons	Value
1918	41, 831	$5, 889, 381	1923	1, 999	$260, 487
1919	10, 510	1, 471, 256	1924	5, 332	711, 147
1920	2, 730	462, 223	1925	4, 955	784, 440
1921	1, 624	177, 926	1926	4, 276	601, 061
1922	5, 823	604, 605	1927	2, 533	308, 698

Foreign lead exported from the United States, 1918–1927

Year	Exported from warehouse			Exported in manufactures with benefit of drawback (pounds)
	Pigs, bars, and old[1]		All other manufactures	
	Pounds	Value		
1918	118, 832, 344	$8, 309, 798	$4, 347	6, 852, 173
1919	81, 951, 396	4, 536, 273	44	3, 872, 130
1920	34, 725, 501	2, 570, 535	35, 146	12, 350, 794
1921	50, 000, 259	2, 284, 107	613	18, 738, 927
1922	64, 709, 305	3, 177, 360	146	11, 354, 070
1923	97, 471, 326	5, 195, 256	(2)	25, 052, 107
1924	153, 515, 863	9, 685, 619	(2)	30, 549, 116
1925	197, 128, 517	14, 910, 891	(2)	23, 398, 305
1926	135, 319, 321	8, 904, 603	(2)	35, 910, 934
1927	245, 467, 875	12, 508, 566	(2)	23, 129, 750

[1] Since July 1, 1915, the Bureau of Foreign and Domestic Commerce has classed all foreign lead smelted or refined in this country and exported as "domestic exports of pigs, bars, etc., produced from foreign ore." The above figures include also the exports of foreign lead imported in the form of pigs and bars.

[2] Not separately classified after 1922.

Domestic and foreign pig lead exported from the United States, 1926 and 1927, by destinations

Destination	Domestic		Foreign	
	Short tons	Value	Short tons	Value
1926				
North America:				
Canada	127	$27, 441	(1)	$32
Cuba	60	11, 152	302	42, 442
Mexico	59	12, 489	56	7, 942
Panama	27	5, 340		
Other	42	8, 504	7	1, 141
	315	64, 926	365	51, 557
South America:				
Argentina	41	7, 539	386	50, 852
Brazil	46	9, 259	1, 709	225, 306
Chile	143	23, 320	972	142, 584
Colombia	245	37, 930	18	2, 820
Guiana, Netherland (Surinam)	3	546	392	58, 050
Peru	29	4, 840	44	7, 003
Uruguay	29	3, 697	450	61, 265
Other	16	3, 153	56	8, 944
	552	90, 284	4, 027	556, 824
Europe:				
Belgium	336	44, 775	2, 016	267, 945
France	392	50, 200	7, 416	982, 599
Germany	896	115, 548	16, 827	2, 185, 163
Italy			840	124, 789
Netherlands	56	6, 675	1, 714	226, 698
Sweden	112	14, 350	2, 829	365, 754
United Kingdom	925	120, 840	14, 370	1, 937, 448
Other	58	8, 381	280	36, 265
	2, 775	360, 769	46, 292	6, 126, 661
Asia:				
China	(1)	12	2, 864	355, 779
Japan	504	64, 209	14, 022	1, 800, 822
Philippine Islands	72	13, 175	38	6, 461
Other	56	7, 141	52	6, 499
	632	84, 537	16, 976	2, 169, 561
Africa	2	545		
	4, 276	601, 061	67, 660	8, 904, 603

[1] Less than 1 ton.

Domestic and foreign pig lead exported from the United States, 1926 and 1927, by destinations—Continued

Destination	Domestic		Foreign	
	Short tons	Value	Short tons	Value
1927				
North America:				
Canada	94	$20,018	26	$5,250
Cuba	55	9,017	147	18,629
Mexico	45	9,734	1	93
Panama	16	2,898	50	6,730
Other	35	5,660	22	2,897
	245	47,327	246	33,599
South America:				
Argentina	37	3,408	1,657	173,406
Brazil	6	911	2,415	250,483
Chile	1,248	141,193	2,285	292,300
Colombia	41	7,829	52	7,814
Peru	6	813	84	9,316
Uruguay	----------	----------	395	45,290
Other	16	2,766	282	30,474
	1,354	156,950	7,170	809,083
Europe:				
Belgium	----------	----------	1,495	155,438
France	----------	----------	7,694	725,860
Germany	----------	----------	32,734	3,258,650
Italy	----------	----------	336	35,618
Netherlands	----------	----------	4,755	459,386
Sweden	----------	----------	4,269	428,650
United Kingdom	112	14,006	38,222	3,856,461
Other	1	287	5,320	573,232
	113	14,293	94,825	9,493,295
Asia:				
China	(1)	45	3,615	393,815
Japan	561	59,222	16,335	1,712,127
Philippine Islands	59	9,155	13	1,142
Other	201	21,645	400	46,322
	821	90,067	20,363	2,153,406
Africa	(1)	16	50	4,871
Oceania, including Australia	(1)	45	80	14,312
	2,533	308,698	122,734	12,508,566

[1] Less than 1 ton.

CONSUMPTION

Apparent consumption of refined primary lead in the United States, refinery stocks disregarded, 1923–1927, in short tons

	1923	1924	1925	1926	1927
Supply:					
Stock in bonded warehouse Jan. 1	----------	2,617	5,015	8,162	10,711
Imports of pigs, bars, and old[1]	21,099	12,247	7,021	11,152	2,467
Production	618,322	690,493	766,969	798,941	796,530
	639,421	705,357	779,035	818,255	809,708
Withdrawn:					
Exports of foreign lead—					
From warehouse	48,736	76,758	98,564	67,660	122,734
In manufactures, with benefit of drawback	12,526	15,275	11,699	17,955	11,565
Exports of domestic lead	1,999	5,332	4,955	4,276	2,533
Stock in bonded warehouse Dec. 31	2,617	5,045	8,162	10,711	9,464
	65,878	102,410	123,380	100,602	146,296
Apparent consumption	573,543	602,947	655,655	717,653	663,412

[1] Includes 622 tons of "old, reclaimed, and scrap" in 1925 and 1,135 tons in 1926. Corresponding figures for other years not separately recorded.

PRICE

According to the following table the high quoted average monthly price in 1927 was for March, when it reached 7.61 cents per pound. The low monthly average was for October, when it had declined to 6.26 cents per pound. From the high point in March to the low point in October the decline was gradual, with the exception of August, when an average of 6.68 cents was recorded. From the low point in October the quoted price gradually rose until an average of 6.51 cents per pound was reached in December. The following table gives the average monthly quoted price of lead at New York (outside market) from 1924 to 1927.

Average monthly quoted price of lead at New York (outside market), 1924–1927, in cents a pound [1]

Month	1924	1925	1926	1927	Month	1924	1925	1926	1927
January	8.43	10.33	9.35	7.58	July	7.19	8.31	8.63	6.36
February	9.18	9.41	9.17	7.48	August	7.95	9.81	8.91	6.68
March	9.33	8.90	8.50	7.61	September	8.07	9.61	8.78	6.31
April	8.20	8.02	8.04	7.11	October	8.37	9.68	8.40	6.26
May	7.32	8.20	7.81	6.60	November	9.01	9.84	8.00	6.28
June	7.01	8.44	8.11	6.43	December	9.62	9.40	7.86	6.51

[1] American Metal Market, monthly review section.

The following prices were quoted on lead by the American Smelting & Refining Co. for 1926 and 1927 in cents a pound.

1926		1927	
Feb. 11	9.15	Jan. 6	7.65
Feb. 25	9.00	Jan. 20	7.50
Mar. 1	8.90	Jan. 25	7.40
Mar. 3	8.75	Mar. 2	7.55
Mar. 8	8.60	Mar. 3	7.65
Mar. 10	8.40	Mar. 23	7.55
Mar. 12	8.20	Mar. 25	7.45
Apr. 7	8.00	Mar. 29	7.35
Apr. 19	7.85	Apr. 4	7.25
May 11	7.75	Apr. 18	7.15
May 21	7.65	Apr. 20	7.00
June 10	7.80	Apr. 28	6.85
June 11	8.00	May 2	6.75
June 15	8.15	May 16	6.65
June 16	8.25	May 19	6.50
July 13	8.40	May 26	6.40
July 14	8.50	July 1	6.30
July 23	8.65	July 7	6.20
July 26	8.75	July 20	6.30
July 30	8.90	July 21	6.40
Sept. 13	8.75	July 22	6.50
Oct. 1	8.65	July 29	6.60
Oct. 6	8.50	Aug. 3	6.75
Oct. 13	8.35	Aug. 24	6.60
Oct. 25	8.25	Aug. 30	6.50
Nov. 1	8.10	Sept. 6	6.40
Nov. 3	8.00	Sept. 9	6.25
Dec. 6	7.90	Nov. 28	6.30
Dec. 15	7.80	Nov. 29	6.40
		Dec. 1	6.50

The average selling value of lead in 1927, based on total sales by producers, was 6.3 cents a pound, compared with 8 cents a pound in 1926 and 1924, and 8.7 cents a pound in 1925.

SECONDARY METALS

By J. P. Dunlop[1]

INTRODUCTION

SCOPE OF REPORT

"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses, and are so called to distinguish them from metals derived directly from ores which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or from waste material vary in purity and in adaptability to use in making certain products. The figures furnished by producers cover seven metals—secondary copper, zinc, lead, tin, antimony, aluminum, and nickel—and are supplemental to those on the primary metals. They are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential addition to the figures given in the general reports on the primary metals and will become more essential in the future.

"Secondary metal" was very aptly defined at the February, 1928, meeting of the American Institute of Mining and Metallurgical Engineers "as that which had lost its original identity as to source."

RECOVERY, TREATMENT, AND USE OF WASTE MATERIAL

The collection of waste material is an established branch of industry. It involves the collection, sorting, and shipment of waste having an estimated value of more than a billion dollars yearly; it has advanced in honesty, efficiency, and usefulness, and it is growing rapidly. This report covers only a part of the waste metals of certain classes and only a very small part of the wide variety of waste materials that are marketed.

Much of the waste from country collections and small dealers requires careful sorting, and this is not easy to do by visual examination alone when there are so many alloys used in various products.

The waste metal industry and its problems of salvage, refining, and economic use received more attention in 1927 than ever before. The problems are no longer viewed academically by many large consumers of metals as there is the vital necessity for economy in many branches of business. The American Institute of Mining and Metallurgical

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Engineers considered the problems of scrap metals and wastes sufficiently important to have various papers on those subjects prepared, presented, and discussed at its meeting held in New York in February, 1928. Some of the papers read are as follows:

Sampling and Evaluating Secondary Nonferrous Metals, by T. A. Wright.[2]

Classification and Preparation of Nonferrous Scrap Alloys and Castings, by H. F. Siefert.

Contamination of Metal Scrap—Its Effect on the Value and Suggested Means of Control, by Carl O. Thieme.

The Modern Nonferrous Secondary Metal Producers, by Don C. Blackman.

Foundry Slag, by E. E. Darby.

Nonferrous Secondary Metals Recovered in the United States, by J. P. Dunlop.

Secondary Aluminum, by T. D. Stay, D. B. Hobbs, and H. O. Burrows.

After the reading of the papers William Crawford Hirsch, who has been identified with the primary and scrap metal trade for many years and who during the World War wrote a series of articles entitled "Warring on Waste," made some pertinent remarks that deserve perusal by all engaged in the metal trades. They are as follows:

> Properly managed, the equipment provided for the conservation of scrap, and the time and effort given in its systematic accumulation, supervision, and disposal will prove not only distinctly profitable, but the indirect return which will come from the enhanced care that will be accorded to new material is certain to prove of incalculable value. There is perhaps no more reliable index to the state of an individual enterprise than the manner in which its scrap is handled. The day of the salvage expert is beginning to dawn. At first he will have to work out his own salvation; later his vocation will become a profession, the theory of which will be taught in universities and colleges. Low prices for virgin metals and high costs threaten to completely dry up the important collection of household, farm, and other scrap, and when a national emergency occurs we will suffer. Poke all the fun you want at the junkman, but keep him in business. After all, economically he takes his place by the side of the miner—and look at all the praises the poets have heaped upon that noble calling.
>
> The scrap market really deals with two distinct classes of scrap. One consists of unalloyed scrap such as crucible copper, tin, block pipe, lead and zinc and aluminum clippings. I have yet to hear a convincing argument why these should be quoted on any other but a percentage base of these respective primary metals allowing for metal loss and cost. In practice, of course, their price is made on that very basis, but the unfortunate part is that separate quotations expressed in cents, instead of a per cent of virgin metal price, tend to create in the minds of many consumers the erroneous impression that a wide gulf separates scrap from virgin metals, when, in fact, crucible copper scrap metallurgically is on a parity with casting copper quoted in the list of primary metals which is frequently a secondary product.
>
> The other classes of scrap with which the merchant deals consist of alloys and drosses. Their value is determined far more by the ingenuity of the specialist who treats them and leads them into the avenue of consumption where they can be most economically utilized than by mere market conditions.
>
> The peace time importance of secondary metals, our second line of defense in time of war, is steadily growing. Scrap holds the balance of power in the metal markets, preventing combinations of producers from overreaching themselves. More light is needed on our invisible supplies and on the rapidity or, perhaps, the slowness with which metals in their various uses return as scrap.
>
> Certain it is that there will be a steadily widening field for the technical knowledge and systematic research of the metallurgist who makes possible more efficient and economic utilization of secondary metals.

That there has been a marked increase in the interest shown in the problem connected with metal wastes and their recovery and use is undeniable. The necessity of reducing costs and the lack of adequate profit in the last two years have stimulated cooperation and research. A number of new associations have been started, some of which are

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[2] Also published in Metal Industry, July, August, and September, 1928.

The Non-Ferrous Metal Institute, White Metal Smelters Association of Chicago, Eastern Scrap Iron Association, and Salvage Division of the National Association of Waste Material Dealers (Inc.). The membership of the last-named association includes many of the largest industrial corporations in the United States producing widely diversified products not necessarily made of metal, and indicates that every industry has its problem of waste material and that the large corporations realize that it is profitable to bring about new methods of conservation. Some of the subjects discussed at the meetings of the Salvage Division were as follows:

Fifty-seven varieties of salvage.

Salvaging problems where plants are scattered.

Industrial scrap from the viewpoint of a scrap-iron dealer.

The benefits of salvage and reclamation from a service-rendering standpoint.

The relations of the dealer in the waste-material industry to the producer and consumer.

Relation between the business and the technical phases of salvage and its disposal.

The seller's obligation to secure no more than a fair price for his scrap.

Problems connected with the disposal of surplus and obsolete equipment confronting traction companies.

Problems connected with disposal of surplus or obsolete material.

Growth and importance of salvage operations of American railroads.

Should large corporations sell only on sealed bids opened in the presence of buyers?

Salvage material in the automobile industry.

The Non-Ferrous Metal Institute is concerned largely with ingot metals made from scrap and is endeavoring to develop a method of standardizing the products and promoting their more extended use so as to remedy the unsound situation now prevailing in the industry.

The increasing interest in waste materials clearly shows that in the future the proper use of scrap will materially contribute to the profits of nearly every branch of industry. It may be that such savings will constitute most of the profit.

The earlier chapters on "Secondary metals" in Mineral Resources contain much information regarding the collection of waste material. Various trade papers, such as the Waste Trade Journal, Daily Metal Trade, Brass World, American Metal Market, Foundry, Iron Age, Iron Trade Review, Metal Industry, and Daily Metal Reporter, also contain valuable information relating to prices and marketing of scrap metal and drosses and technical information relating to the proper use of old metals.[3]

CLASSIFICATION OF OLD METALS

The classification of old metals drawn up by the Metal Division of the National Association of Waste Material Dealers (Inc.) (Times Building, New York, N. Y.) and changed from time to time as desirable is the standard of both dealers and manufacturers in the United States. The latest classification (Circular K), effective March 1,

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[3] Metal Industry, Value of a Business Publication: July, 1926, p. 290.

1928, follows; attention is directed to items 2, 10, and 12, which show changes in the specifications relating to copper wire, heavy yellow brass, and light brass.

STANDARD CLASSIFICATION FOR OLD METALS, EFFECTIVE FROM MARCH 1, 1928

1. *Delivery.*—(*a*) Delivery of more or less of the specified quantity up to 2½ per cent is permissible.

(*b*) If the term "about" is used, it is understood that 5 per cent more or less of the quantity may be delivered.

(*c*) Should the seller fail to make deliveries as specified in the contract, the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver, and if unable to agree on the amount of damages an arbitration committee of the National Association of Waste Material Dealers (Inc.), appointed for this purpose, to determine the amount of such damages.

(*d*) In the event that buyer should claim the goods delivered on a contract are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute shall be referred to an arbitration committee of the National Association of Waste Material Dealers (Inc.), to be appointed for that purpose.

(*e*) A carload, unless otherwise designated, shall consist of the weight governing the minimum carload weight at the lowest carload rate of freight in the territory in which the seller is located. If destination of material requires a greater carload minimum weight, buyer must so specify.

(*f*) A ton shall be understood to be 2,000 pounds unless otherwise specified. On material purchased for direct foreign shipment a ton shall be understood to be a gross ton of 2,240 pounds unless otherwise specified.

(*g*) If, through embargo, a delivery can not be made at the time specified, the contract shall remain valid and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed.

(*g*–1) When shipments for export for which space has been engaged have been delivered or tendered to a steamship for forwarding and through inadequacy of cargo space the steamship can not accept the shipment, or where steamer is delayed in sailing beyond its scheduled time, shipment on the next steamer from the port of shipment shall be deemed a compliance with the contract as to time of shipment.

(*h*) In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn public weigher shall be employed, and the party most in error must pay the costs of handling and reweighing.

(*i*) When material is such that it can be sorted by hand, consignees can not reject the entire shipment if the percentage of rejection does not exceed 10 per cent. The disposition of the rejected material should then be arranged by negotiations; no replacement of the rejected material to be made.

Upon request of the shipper, rejections shall be returnable to the seller on domestic shipments within one week and on foreign shipments within 30 days from the time notice of rejection is received by them, and upon payment by them of 1 cent a pound on material rejected to cover cost of sorting and packing; the seller to be responsible for freight both ways.

2. *No. 1 copper wire.*—To consist of clean untinned copper wire not smaller than No. 16 B. & S. Wire gauge to be free from burnt copper wire which is brittle and all foreign substances.

3. *No. 2 copper wire.*—To consist of miscellaneous clean copper wire which may contain a percentage of tinned wire and soldered ends but to be free of hair wire and burnt wire which is brittle; the tinned wire not to be over 15 per cent of the total weight.

4. *No. 1 heavy copper.*—This shall consist of copper not less than $\frac{1}{16}$ inch thick, and may include trolley wire, heavy field wire, heavy armature wire, that is not tangled, and also new untinned and clean copper clippings and punchings, and copper segments that are clean.

5. *Mixed heavy copper.*—May consist of tinned and untinned copper, consisting of copper clippings, clean copper pipe and tubing, copper wire free of hair wire and burnt and brittle wire, free from nickel-plated material.

6. *Light copper.*—May consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free from radiators, brass, lead and solder connections, readily removable iron, old electrotype shells, and free of excessive paint, tar and scale.

7. *Composition or red brass.*—May consist of red scrap brass, valves, machinery bearings and other parts of machinery, including miscellaneous castings made of copper, tin, zinc and/or lead, no piece to measure more than 12 inches over any one part or to weigh over 60 pounds, to be free of railroad boxes and other similarly excessively leaded material, cocks and faucets, gates, pot pieces, ingots, and burned brass, aluminum composition, manganese, and iron.

8. *Railroad bearing.*—Shall consist of railroad boxes or car journal bearings, must be old standard used scrap, free of yellow boxes, also iron-backed boxes, and must be free of babbitt, also free of excessive grease and dirt.

9. *Cocks and faucets.*—To be mixed red and yellow brass, free of gas cocks and beer faucets.

10. *Heavy yellow brass.*—May consist of heavy brass castings, rolled brass, rod brass ends, chandelier brass, tubing, not to contain over 15 per cent of tinned and/or nickel-plated material; no piece to measure more than 12 inches over any one part and must be in pieces not too large for crucibles. Must be free of manganese mixture, condenser tubes, iron, dirt and excessive corroded tubing. Must be free of aluminum brass containing over 0.20 per cent aluminum.

11. *Yellow brass castings.*—Shall consist of brass castings in crucible shape, that is, no piece to measure more than 12 inches over any one part; must be free of manganese mixtures, tinned and nickel-plated material, and must be free of visible aluminum brass.

12. *Light brass.*—May consist of miscellaneous brass, tinned or nickel plated that is too light for heavy brass, to be free of gun shells containing paper, ashes or iron, loaded lamp bases, clock works and automobile gaskets. Free of visible iron unless otherwise specified.

13. *Old rolled brass.*—May consist exclusively of old pieces of sheet brass and pipe free from solder, tinned and nickel-plated material, iron, paint and corrosion, ship sheathing, rod brass, condenser tubes, and Muntz metal material.

14. *New brass clippings.*—Shall consist of the cuttings of new sheet brass to be absolutely clean and free from any foreign substances and not to contain more than 10 per cent of clean brass punchings to be not smaller than ¼ inch in diameter.

15. *Brass pipe.*—Shall consist of brass pipe, free of nickel-plated, tinned, soldered, or pipes with cast brass connections. To be sound, clean pipes free of sediment and condenser tubes.

16. *No. 1 red composition turnings.*—To be free of railroad car box turnings and similarly excessively leaded material, aluminum, manganese, and yellow brass turnings; not to contain over 2 per cent free iron; to be free of grindings and foreign material, especially babbitt. Turnings not according to this specification to be sold subject to sample.

17. *No. 1 yellow rod brass turnings.*—Shall consist of strictly rod turnings, free of aluminum, manganese, composition, Tobin and Muntz metal turnings; not to contain over 3 per cent free iron, oil, or other moisture; to be free of grindings and babbitts; to contain not more than 0.30 per cent tin and not more than 0.15 per cent combined iron.

18. *No. 1 yellow brass turnings.*—Shall consist of yellow brass turnings, free of aluminum, manganese, and composition turnings; not to contain over 3 per cent of free iron, oil, or other moisture; to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.

19. *Auto radiators.*—All radiators to be subject to deduction of actual iron The tonnage specification should cover the gross weight of the radiators.

20. *No. 1 pewter.*—Shall consist of tableware and soda-fountain boxes, but in any case must test 84 per cent tin. Syphon tops to be treated for separately.

21. *Zinc.*—Must consist of clean sheet and cast zinc, also cast batteries to be free of loose oxide and dross, salamoniac cans, and other foreign materials.

22. *Zinc dross.*—Must be unsweated in slabs and must contain a minimum of 92 per cent of zinc.

23. *Tin foil.*—Shall consist of pure foil free of lead compositions and other foreign ingredients and matters.

24. *Electrotype shells.*—Must be hand picked and free of loose dross and chunk of dross.

25. *Scrap lead.*—Should be clean, soft scrap lead.

26. *Battery lead plates.*—Shall consist of dry battery lead plates, moisture not to exceed 1 per cent, allowance to be made for wood, rubber and paper and excess moisture.

27. *New sheet aluminum clippings and new aluminum wire.*—Shall consist of new sheet aluminum, cuttings and new aluminum wire. Must be free from oil,

grease, and any other foreign substances. Must be guaranteed not less than 98 per cent pure aluminum and not to contain more than 10 per cent of clean aluminum punchings to be not smaller than ¼ inch in diameter.

28. *Old aluminum wire.*—Shall consist of old aluminum wire guaranteed 98 to 99 per cent pure aluminum and must be free from iron cores, insulation, and any other foreign substance.

29. *Alloy sheet aluminum.*—To be sold on specification and sample.

30. *Painted sheet aluminum.*—Shall consist of painted sheet aluminum and must be absolutely free from iron, dirt, or any other foreign substance.

31. *Old sheet aluminum.*—Shall consist of old and manufactured sheet aluminum. Must be free from painted sheet aluminum, iron, dirt, and any other foreign substance.

32. *Aluminum castings.*—Shall consist of aluminum castings, free from iron, babbitt, brass and any other foreign substance. Must not exceed 2 per cent of oil and grease. Free of pistons.

33. *Aluminum borings.*—To avoid dispute, should be sold subject to sample.

34. *Aluminum foil.*—Shall consist of pure aluminum foil, free from paper and any foreign ingredients.

35. *Babbitt metal.*—Shall contain bearing metal of all kinds. Shall not contain scrap hard metal, Allen metal (which is copper and lead alloy) die cast, zinc boxes or type metal.

36. *Packages.*—Shall be good strong packages suitable for shipment, and each package shall be plainly marked with separate shipping marks and numbers and with the gross and tare weights so that the packages may reach their destination and their weights can be easily checked.

REVIEW OF THE SECONDARY METAL INDUSTRY IN 1927

MARKET CONDITIONS

The outstanding feature of the secondary metal trade was the nearly general expansion in the quantity of material treated and used. The total increase in quantity of secondary metals was only 1 per cent, but it occurred in a year for which the American Bureau of Metal Statistics estimates that the domestic consumption of copper decreased nearly 8 per cent, that of lead nearly 7 per cent, and that of zinc about 6 per cent and in which there were also decreases in the domestic consumption of tin and antimony. The only secondary metals that showed decreases in quantity recovered were lead, zinc, and antimony, and of these only antimony showed an important decrease. Owing to the decreases in the average yearly prices, the total value of the output of secondary metals in 1927 was about $18,000,000 less than in 1926. A decrease was recorded in the total value of each metal except tin and nickel. The increases in the quantities of tin and nickel recovered in alloys, however, were large enough to more than compensate for the slightly decreased average price of those metals. Notwithstanding decreased activity in building operations, at automotive plants, and in use of materials by railroads, business was fairly active, and secondary smelters sold as much as they did in 1926. Again, the complaint was general that profits were unsatisfactory and not commensurate with the volume of business. Probably on the whole profits were slightly greater, but competition was strong and price fluctuations too small and gradual to permit more than a meager return of interest on capital investment and turnover of material. Consolidation of interests continued in 1927, and gradually the smaller units that supply local trade are disappearing. The waste-metal trade is ever tending to concentrate in those plants that can adequately supervise technical treatment and that can extend the use of secondary metals by guaranteeing the products and by showing that their use will lower costs without reducing the quality of the products manufactured.

Another feature of 1927 that bodes well for the future of the waste-metal industry was the increased interest manifested by large corporations and their endeavor to stabilize quality and prices.

Another salient feature of the secondary metal trade in 1927 was the large increase in the exports of scrap metals which were about double those in 1926. Most of this activity centered in the purchase of scrap copper and brass scrap by foreign representatives on the eastern coast; most of the exports went to Germany. These exports may have increased because of the controlled foreign selling of the United States Copper Exporters (Inc.), but undoubtedly they were fostered by the scarcity of European scrap and by the efficient methods of treatment and lower refining costs in Germany which enabled the German buyers of cuprous scrap to pay slightly higher prices than consumers in other continental countries or in the United States

PRICES OF SOME SCRAP METALS AND ALLOYS

The tables that follow show certain scrap-metal prices at New York in 1927 as quoted by the Waste Trade Journal and the American Metal Market.

The dealers' weekly average buying price in New York of No. 1 heavy scrap copper ranged from 10.75 to 11.15 cents a pound during January and February. Early in March it was as high as 11.25 cents but weakened in April to 11.15 cents and in the first week in May to 11 cents. In the second week in May it was again 11.15 cents but decreased to 10.65 cents at the end of the month. In June the prices were from 10.65 to 10.75 cents. The last two weeks in July the market strengthened to 10.90 and 11 cents. The August, September, and October quotations ranged from 11 to 11.25 cents. There was another increase in November when prices advanced from 11.50 cents during the first three weeks to 11.75 during the last week. In December the prices quoted were 12.25 cents early in the month but declined to and closed the year at 12.15 cents. The highest quotation was 12.25 cents in December, and the lowest was 10.65 cents in certain weeks of May, June, and July.

No. 1 composition scrap (red brass) showed a range of 1 cent a pound in 1927 compared with a range of 0.75 cent a pound in 1926. It was quoted at 8.90 to 9.15 cents in January, was lowest at 8.75 cents in February, and was highest at 9.75 cents in December and closed the year at that price.

The price of heavy scrap lead began the year at 6.60 cents a pound, was a little lower in February, and in March reached the highest quotation of the year, 6.75 cents. A rapid downward trend started at the end of March and continued until June, when the average price was steady at 5.25 cents. The prices stiffened during July and August and ranged from 5.15 to 5.75 cents. Another sharp turn downward began the first week in September, and prices during September, October, and November ranged from 5.15 to 5.26 cents. There was a sharp advance early in December to 5.40 cents, and this price held steadily until the end of the year. The highest price was 6.75 cents in March, and the lowest was 5.10 cents in May.

The range in the price of scrap zinc in 1927 was 1 cent a pound compared with 0.85 cent a pound in 1926. The price was 4.40 cents early in January and as low as 3.40 cents in November. After opening at 4.40 cents in January the price declined to 4.10 cents by the end of the month but increased in February and March until the quotation was again 4.40 cents. By the middle of April it had declined to 4.15 cents and by the end of May to 3.90 cents. It held at 3.90 cents until the end of August, the first week in September increased to 4.15 cents, but in the next week dropped again to 3.90 cents. The price declined to 3.75 cents in October and reached the lowest point of the year, 3.40 cents, in November. Late in November it advanced slightly and ended the year at 3.60 cents.

There was a larger range in the quoted prices of cast aluminum alloys than in most scrap metals, and in 1927 the prices ranged from a high of 15.25 cents a pound in January to a low of 11.50 cents in December. After the first week in April the general trend was downward. New aluminum clippings ranged in price from a high of 19.19 cents a pound in April to a low of 18.13 cents in December. The trend of prices was downward from April to December.

The price of secondary tin usually follows the trend of prices for primary 99 per cent tin which had a range of 13 cents a pound during 1927. Block-tin pipe was quoted as high as 56.24 cents in January and as low as 50 cents in November and December.

Antimonial lead scrap was not in as active demand in 1927 as in 1926, owing to the considerably lower prices of antimony and lead and the smaller consumption for automotive batteries.

Scrap nickel and nickel alloys were in good demand during 1927. The price of primary nickel was stable all the year, so there were few fluctuations in the price of metal scrap.

Average scrap-metal prices in 1927, in cents per pound[1]

[New York dealers' weekly average buying prices]

Date	No. 1 heavy copper	No. 1 composition	Heavy lead	Scrap zinc	Cast aluminum	Date	No. 1 heavy copper	No. 1 composition	Heavy lead	Scrap zinc	Cast aluminum
Jan. 1	11.15	9.15	6.60	4.40	14.75	July 2	10.65	9.15	5.40	3.90	13.00
8	10.90	8.90	6.50	4.40	14.75	9	10.65	9.15	5.25	3.90	13.00
15	11.15	9.15	6.50	4.15	15.25	16	10.75	9.25	5.15	3.90	13.00
22	11.00	9.15	6.50	4.15	15.25	23	10.90	9.40	5.25	3.90	13.00
29	10.90	9.00	6.40	4.10	14.50	30	11.00	9.50	5.40	3.90	13.25
Feb. 5	11.00	8.90	6.25	4.10	14.25	Aug. 6	11.15	9.50	5.50	3.90	12.25
12	10.75	8.75	6.25	4.15	14.25	13	11.25	9.50	5.75	3.90	13.25
19	10.90	9.15	6.40	4.15	14.25	20	11.15	9.40	5.65	3.90	12.25
26	11.00	9.15	6.40	4.25	14.50	27	11.00	9.45	5.40	3.90	13.25
Mar. 5	11.25	9.40	6.60	4.25	14.50	Sept. 3	11.15	9.75	5.15	4.15	13.25
12	11.15	9.40	6.75	4.40	14.75	10	11.15	9.50	5.15	3.90	13.15
19	11.25	9.40	6.75	4.40	14.75	17	11.15	9.40	5.15	3.90	13.25
26	11.20	9.40	6.50	4.40	14.90	24	11.15	9.40	5.15	3.90	13.25
Apr. 2	11.15	9.40	6.40	4.40	14.90	Oct. 1	11.00	9.40	5.15	3.90	13.15
9	11.15	9.40	6.25	4.25	14.75	8	11.15	9.40	5.15	3.90	13.25
16	11.15	9.40	6.15	4.15	14.50	15	11.15	9.40	5.15	3.90	13.25
23	11.15	9.40	5.50	4.15	14.25	22	11.25	9.65	5.20	3.90	13.25
30	11.15	9.40	5.50	4.15	14.25	29	11.25	9.65	5.20	3.75	12.75
May 7	11.00	9.40	5.50	4.15	14.15	Nov. 5	11.50	9.65	5.26	3.65	12.75
14	11.15	9.40	5.40	4.15	14.00	12	11.50	9.65	5.20	3.65	12.75
21	10.90	9.40	5.15	4.15	13.65	19	11.50	9.65	5.15	3.40	12.25
28	10.65	9.15	5.10	3.90	13.75	26	11.75	9.75	5.15	3.40	12.25
June 4	10.65	9.25	5.25	3.90	13.75	Dec. 3	12.00	9.75	5.40	3.50	12.25
11	10.75	9.40	5.25	3.90	13.25	10	12.25	9.75	5.40	3.50	12.25
18	10.75	9.40	5.25	3.90	13.00	17	12.15	9.75	5.40	3.50	12.25
25	10.65	9.40	5.25	3.90	12.75	24	12.15	9.75	5.40	3.50	11.50
						31	12.15	9.75	5.40	3.60	11.50

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[1] Waste Trade Journal, New York, Jan. 28, 1928.

The following monthly average prices at New York in 1927 for new scrap-zinc clippings, old zinc, block-tin pipe, and new aluminum clippings, in cents per pound, were quoted by the American Metal Market.

Average scrap-metal prices at New York in 1927, in cents per pound [1]

Month	New scrap-zinc clippings	Old zinc	Block-tin pipe	New aluminum clippings	Month	New scrap-zinc clippings	Old zinc	Block-tin pipe	New aluminum clippings
January	5.42	4.04	56.24	19.06	August	5.12	3.87	54.57	18.75
February	5.19	3.94	55.00	18.75	September	5.12	3.87	53.10	18.75
March	5.37	4.12	55.00	18.82	October	5.10	3.82	50.35	18.57
April	5.19	4.03	55.00	19.19	November	4.56	3.62	50.00	18.25
May	5.12	3.90	55.00	19.00	December	4.37	3.62	50.00	18.13
June	5.12	3.87	55.00	18.75					
July	5.12	3.87	55.00	18.75	Year	5.07	3.88	53.69	18.73

[1] Metal Statistics, 1928.

SECONDARY METALS RECOVERED

The quantity of the metals contained in numerous alloys made partly or wholly from secondary material can not be ascertained definitely. The figures given as the result of the annual canvass are only approximate, but they constitute the sole available data on an important industry.

The decrease in the value of the secondary metals, exclusive of gold, silver, platinum, iron, steel, and ferro-alloys, recovered in the United States in 1927 was due mainly to the lower average yearly prices of secondary copper, lead, zinc, aluminum, antimony, and tin.

The quantity of secondary platinum metals recovered in the United States in 1927 was 53,072 troy ounces, about 6,900 ounces more than in 1926, and equaled 36 per cent of the platinum metals imported for consumption in 1927.

The value of the gold and silver contained in old jewelry, dental waste, tableware, ornaments, and other articles remelted or refined in 1927 was $26,858,230. Mints and refineries reported the recovery of 7,157,592 fine ounces of silver and $22,799,876 in gold from waste or discarded material. Jewelry and dental waste furnished the largest supplies of secondary gold and silverware and photographic waste the largest amount of secondary silver.[4] The consumption of silver in the arts and industries in the United States in 1927 is estimated at 38,648,700 ounces. Most of the silver recovered from photographic waste is obtained from solutions and is recovered by the larger makers of films and plates and by the motion-picture industry.[5] Generally these solutions contain less than half an ounce of silver to the gallon. The recovery from waste film is probably 800 ounces to the million feet.[6]

The quantity and value of the scrap iron and steel consumed annually is larger than that of any other waste material. There are more than 3,000 scrap iron and steel yards, many of which have extensive equipment, in the United States. No data are collected by the Bureau of Mines showing the quantity of secondary ferrous metals recovered, but it is estimated that, exclusive of the scrap available at steel mills, railways, and large manufacturing plants, more than 5,000,000 tons of miscellaneous ferrous scrap is collected and sold annually. This estimate does not include rails, pipe, machinery, and other equipment renovated and sold for original use. This use of old material is very extensive in all parts of the country. In general, the dealers and brokers in scrap ferrous metals did not find operations very profitable in 1927, and the business mortality in this line of trade was large.

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[4] Hoke, C. M., Methods of Handling Gold and Platinum Wastes: Metal Industry, June, 1927, pp. 240–242, and September, 1927, pp. 371–372.

[5] Weisburg, Louis, Recovery of Silver from Solutions Used in Photographic Work: U. S. Patent 1527942, Feb. 24, 1925.

[6] Byers, C. A., Recovery of Silver from Movies' Laboratory Waste: Eng. and Min. Jour.-Press, Aug. 26, 1922, p. 373.

The larger part of both the ferrous and nonferrous scrap is derived from, refined in, and used in the Eastern and Central States, although there has been a considerable increase in the last two years in operations in California and some Southern States.

Secondary metals of certain classes recovered in the United States, 1926 and 1927

	1926		1927	
	Short tons	Value	Short tons	Value
Copper, including that in alloys other than brass	281,700	$78,876,000	290,000	$75,980,000
Brass scrap remelted	283,000	65,918,000	286,000	60,516,400
Lead as metal	125,000	44,368,000	119,000	34,776,000
Lead in alloys	152,300		157,000	
Zinc as metal	64,570	11,700,000	64,800	9,881,600
Zinc in alloys other than brass	13,430		12,400	
Tin as metal	9,750	42,511,500	8,800	46,302,100
Tin in alloys and chemical compounds	23,650		28,100	
Antimony as metal	2,910	5,164,400	1,700	3,060,300
Antimony in alloys	13,320		10,700	
Aluminum as metal	20,500	23,868,000	23,000	23,469,600
Aluminum in alloys	23,700		23,200	
Nickel as metal	485	2,135,000	480	2,366,000
Nickel in nonferrous alloys and salts	2,565		2,900	
	----------	274,540,900	----------	256,352,000

The following table illustrates the extension of the scope of inquiry relating to secondary metals and the rapid growth in quantity of certain metals recovered from secondary sources.

Secondary metals of certain classes recovered in the United States, 1910–1927, in short tons

	1910	1911	1912	1913	1914	1915
Copper, including that in alloys other than brass	51,000	50,845	66,441	66,980	58,556	99,937
Brass scrap remelted	62,000	80,370	101,523	99,315	99,038	137,500
Lead as metal	29,492	27,389	30,266	33,104	29,337	36,400
Lead in alloys	25,930	26,895	36,902	39,730	31,725	42,500
Zinc as metal	41,223	40,513	52,251	50,005	42,969	52,900
Zinc in alloys other than brass	2,709	3,223	3,912	3,743	3,914	5,300
Tin as metal	7,217	7,749	8,333	6,415	4,535	5,250
Tin in alloys and chemical compounds	6,686	6,957	7,068	7,763	7,912	8,400
Antimony as metal	9	10	13	45	1	2
Antimony in alloys	2,770	2,359	2,493	2,660	2,645	3,100
Aluminum as metal	(1)	(1)	(1)	2,198	2,791	5,700
Aluminum in alloys	(1)	(1)	(1)	2,456	1,731	2,800
Nickel as metal	(1)	(1)	(1)	(1)	(1)	(1)
Nickel in nonferrous alloys and salts	(1)	(1)	(1)	(1)	(1)	(1)
Total quantity	229,036	246,310	309,202	314,414	285,154	399,789
Total value	$45,525,500	$52,585,390	$77,395,843	$72,786,027	$57,039,706	$114,304,930

[1] No canvass.

Secondary metals of certain classes recovered in the United States, 1910–1927, in short tons—Continued

	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Copper, including that in alloys other than brass	140, 000	159, 400	122, 510	112, 400	130, 600	113, 350	144, 100	193, 200	196, 500	250, 600	281, 700	290, 000
Brass scrap remelted	300, 000	320, 000	328, 800	249, 700	259, 800	148, 500	274, 000	311, 000	274, 000	242, 300	283, 000	286, 000
Lead as metal	56, 700	45, 100	41, 146	55, 684	56, 350	46, 370	75, 480	96, 430	90, 400	112, 420	125, 000	119, 000
Lead in alloys	39, 600	48, 400	55, 954	66, 416	68, 300	57, 410	84, 080	98, 060	114, 100	114, 460	152, 300	157, 000
Zinc as metal	50, 700	31, 400	27, 108	39, 910	42, 850	33, 833	69, 314	65, 210	58, 886	61, 430	64, 570	64, 800
Zinc in alloys other than brass	2, 600	4, 800	11, 082	6, 062	7, 650	5, 840	10, 250	8, 630	10, 500	13, 300	13, 430	12, 400
Tin as metal	7, 600	6, 000	7, 142	5, 977	7, 200	5, 400	6, 570	7, 892	7, 700	7, 950	9, 750	8, 800
Tin in alloys and chemical compounds	9, 800	13, 400	16, 695	18, 056	16, 300	11, 500	12, 940	22, 318	23, 600	23, 000	23, 650	28, 100
Antimony as metal	80	6	43	48	200	29	182	245	90	1	2, 910	1, 700
Antimony in alloys	4, 400	4, 955	5, 183	4, 351	5, 400	4, 691	6, 908	7, 776	9, 314	10, 839	13, 320	10, 700
Aluminum as metal	12, 900	6, 660	6, 050	6, 017	5, 000	3, 650	7, 190	6, 800	10, 350	17, 700	20, 500	23, 000
Aluminum in alloys	6, 400	9, 440	9, 000	12, 674	10, 500	5, 250	9, 100	14, 500	16, 650	26, 300	23, 700	23, 200
Nickel as metal	[2] 16	[2] 60	178	163	270	86	104	177	114	191	485	480
Nickel in nonferrous alloys and salts	[2] 800	[2] 800	1, 215	2, 284	1, 930	859	1, 408	1, 373	2, 126	2, 109	2, 565	2, 900
Total quantity	631, 596	650, 421	632, 106	579, 742	612, 350	436, 768	701, 626	833, 611	814, 330	882, 600	1, 016, 880	1, 028, 080
Total value	$265, 377, 856	$295, 854, 900	$264, 298, 900	$181, 841, 500	$188, 507, 260	$89, 140, 500	$143, 891, 700	$205, 418, 600	$200, 578, 600	$243, 570, 700	$274, 540, 900	$256, 352, 000

[2] Exclusive of recoveries by International Nickel Co. from scrap nickel or alloys.

SECONDARY COPPER

Secondary copper recovered in the United States, 1926 and 1927, and imports and exports of brass and copper scrap, in short tons

	1926	1927
Copper as metal	200, 100	201, 000
Copper in alloys other than brass	81, 600	89, 000
	281, 700	290, 000
Copper from new scrap (not including brass)	55, 000	57, 000
Copper from old scrap (not including brass)	226, 700	233, 000
	281, 700	290, 000
Brass scrap remelted:		
New clean scrap	125, 000	134, 000
Old scrap	158, 000	152, 000
	283, 000	286, 000
Copper content of brass scrap (averaging 70 per cent copper):		
New scrap	87, 500	93, 800
Old scrap	110, 600	106, 400
	198, 100	200, 200

Secondary copper recovered in the United States, 1926 and 1927, and imports and exports of brass and copper scrap, in short tons—Continued

	1926	1927
Total secondary copper (including copper content of brass scrap):		
From new scrap	142,500	150,800
From old scrap	337,300	339,400
	479,800	490,200
Brass scrap imported	4,311	3,993
Scrap copper imported	5,501	3,739
Brass ("ingots, scrap, and old") exported	25,132	45,997
Scrap copper exported	9,713	22,709

The plants refining mainly primary metal recovered 104,934 short tons of the total secondary copper recovered in 1927, or about 7,600 tons less than they reported for 1926. The copper produced by smelters of secondary material included 96,066 tons of pig copper, 89,000 tons of copper in alloys other than brass, and 200,200 tons of copper in remelted brass. These figures indicate increases of 8,525 tons of pig copper, 7,400 tons in alloys other than brass, and 2,100 tons in remelted brass. The total value of the secondary copper, as metal and in alloys, computed at 13.1 cents a pound—the average price for the year of all marketable grades of new metal—amounted to $128,432,400.

The imports of scrap copper in 1927 were about 1,760 tons less and the imports of brass scrap about 300 tons less than in 1926. Most of the imports were from Canada. European exports of brass scrap to the United States, which in 1922 were nearly 72,000 tons, were negligible in 1927.

One of the dominant features in the copper market in 1927 was the large increase in the quantity of scrap copper and brass scrap exported from the United States to Europe. The total exports of scrap copper in 1927 increased 134 per cent and those of brass scrap 83 per cent. Representatives of foreign smelters were eager purchasers in the eastern markets, and most of the metal was shipped from the ports of New York, Philadelphia, and Boston.

Railways produce a large tonnage of both ferrous and nonferrous scrap, most of which they sell or ship to dealers in part payment for new metal. Many railways, however, utilize a considerable quantity of old babbitt, bearing metals, solder, and other metal scraps at their own shops; reports show that in 1927 they reused 2,300 tons of brass, 1,450 tons of copper, and 24,000 tons of copper in alloys other than brass.

SECONDARY LEAD

Secondary lead recovered in the United States, 1926 and 1927, in short tons

	1926	1927
Secondary lead recovered by smelters that treat mainly ore	32,499	38,424
Secondary lead recovered by smelters that treat only scrap and drosses	92,501	80,576
	125,000	119,000
Secondary lead recovered in remelted alloys:		
Lead content of antimonial lead scrap treated at regular lead smelters	11,554	8,553
Lead content of drosses and scrap alloys treated at secondary smelters	140,746	148,447
	152,300	157,000
Total secondary lead recovered	277,300	276,000

Refined primary lead produced in the United States, 1926 and 1927, in short tons

	1926	1927
From domestic ore	680,685	668,320
From foreign ore and base bullion	118,256	128,210
Lead content of antimonial lead from foreign and domestic ores and bullion treated at regular smelters	19,831	21,611

The output of secondary lead in 1927 was equal to 35 per cent of the total refined primary lead produced in the United States and was about 65,600 tons greater than the output of primary lead from ores mined in Missouri, the largest lead-producing State.

The quantity of secondary lead recovered in 1927 was 1,300 tons less than in 1926; that recovered as pig lead was 6,000 tons less, although those smelters whose product is mainly primary metal reported 5,925 tons more than in 1926. The quantity of lead recovered in alloys increased 4,700 tons, although the regular smelters reported a decrease of about 3,000 tons in the lead content of antimonial lead scrap treated by them.

The main sources of supply of secondary lead are old pipe, lead cable, battery plates, and lead lining of acid tanks, although a large quantity is derived from babbitt, solder, terne metal, type metal, brass, and white metal drosses.

The production of batteries and solder was less in 1927 than in 1926, and consequently the quantity of secondary lead used for these purposes was probably less than in 1926.

SECONDARY ZINC

Secondary zinc[1] *recovered in the United States, 1926 and 1927, and products made from zinc dross, skimmings, and ashes, in short tons*

	1926	1927
Secondary zinc recovered by redistillation	40,799	42,784
Secondary zinc recovered by sweating, remelting, etc.	23,771	22,016
Total zinc recovered unalloyed	64,570	64,800
Zinc recovered in alloys other than brass	13,430	12,400
Zinc recovered in brass (estimated)	63,000	63,200
Zinc dust made from zinc dross	4,889	4,850
Zinc dross used for zinc dust (estimated)	5,732	5,700
Zinc concentrates and ore exported	95,252	46,716
Zinc dross exported	10,461	4,451
Lithopone made from zinc skimmings and ashes	45,356	54,214
Secondary zinc content of lithopone	9,204	10,873
Zinc chloride made from zinc skimmings, ashes, etc	43,106	40,107
Zinc content of zinc chloride made from zinc skimmings, etc	9,481	8,824
Zinc content of zinc sulphate made from zinc skimmings, ashes, etc	603	720

[1] Figures do not include scrap and dross used for lithopone, oxide, zinc dust, or chloride. The use for some of these, especially for zinc chloride, is quite large.

Secondary zinc recovered as pig metal and in alloys (including brass) showed a decrease of 600 tons in 1927. This decrease was in alloys other than brass, as the quantity of zinc in brass (63,200 tons) and the total quantity of zinc recovered as pig metal (64,800 tons) were slightly larger than in 1926.

The recovery of secondary zinc (including that in brass) in 1927 was equal to 24 per cent of the total output of primary zinc in the United States.

The quantity of zinc recovered by redistillation increased from 40,799 tons in 1926 to 42,784 tons in 1927. Of the 1927 total 20,739 tons was recovered at retort smelters that treat mainly ore and 22,045 tons was recovered by redistillation of zinc drosses at six plants that use large graphite retorts with capacities of 600 to 800 pounds instead of small clay retorts such as are used by smelters treating ore or mixed ore and drosses. The six zinc smelters that used the large retorts in 1927 were as follows:

Birmingham Smelting & Refining Co., Birmingham, Ala.
Federated Metals Corporation, Trenton, N. J.
Tottenville Copper Co., Tottenville, N. Y.
General Smelting Co., Philadelphia, Pa.
Superior Zinc Corporation, Philadelphia, Pa.
Wheeling Steel Corporation, Wheeling, W. Va.

Of the secondary zinc recovered unalloyed 66 per cent was obtained by redistillation and the remainder by sweating, remelting, etc. Part of the zinc drosses are sweated and the residues then sold to secondary smelters for redistillation or are sold to makers of chemical compounds. As many of these compounds, such as zinc chloride, lithopone, etc., are made from zinc residues, there is generally active competition for zinc drosses, skimmings, etc. A description of modern practice in producing good zinc from scrap and other wastes, prepared by E. R. Thews, is given in Metal Industry, February, 1927 (pp. 600-602), and March, 1927 (pp. 107-108).

A number of plants, including two in San Francisco, make zinc dust from zinc drosses. It is estimated that 5,700 tons of dross was used in 1927 to make 4,850 tons of zinc dust. Of a total output of 178,171 tons of lithopone (a zinc pigment containing approximately 20 per cent of zinc) 54,214 tons, containing 10,873 tons of zinc, was made from zinc skimmings and ashes, or 8,858 tons more than the quantity of lithopone made from zinc residues in 1926.

The quantity of zinc chloride made in 1927 was 40,125 tons, of which 40,107 tons, containing 8,824 tons of zinc, was made from zinc skimmings, ashes, galvanized clippings, etc. Zinc sulphate, containing 720 tons of zinc, was made from skimmings and a small quantity of galvanized clippings.

The exports of zinc dross decreased from 10,461 tons in 1926 to 4,451 tons in 1927; this decrease probably partly accounts for the increased quantity of lithopone made from zinc residues.

The American Bureau of Metal Statistics estimates that 280,000 tons of zinc (10,000 tons less than in 1926) was used in 1927 for zincking (galvanizing) sheets, forms, tubes, wire, etc. Some zinc chloride and oxide was made from scrap and zincked steel clippings, but the quantity of scrap treated probably did not exceed 3,000 tons, so that the recovery of zinc from that source was very small compared with the consumption of zinc for coating purposes.

SECONDARY TIN

Secondary tin recovered in the United States, 1926 and 1927

	1926	1927
Tin recovered as pig tin.........short tons..	9,750	8,800
Tin recovered in alloys and chemical compounds.........do....	23,650	28,100
	33,400	36,900
Clean tin-plate scrap treated at detinning plants.........long tons..	194,494	198,600
Old tin-coated containers treated.........do....	11,942	12,824
Metallic tin recovered at detinning plants.........pounds..	2,292,000	2,288,000
Tin content of tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants.........pounds..	4,094,000	4,462,000
Total tin recovered at detinning plants.........do....	6,386,000	6,750,000
Tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants.........pounds..	8,634,000	9,882,000
Average quantity of tin recovered per long ton of old tin-coated containers.........pounds..	16.74	16.24
Average quantity of tin recovered per long ton of clean tin-plate scrap....do....	32.7	32.9

Tin (metal) and tin concentrates (tin content) imported into the United States, 1926 and 1927, in short tons

	1926	1927
Tin imported as metal.........	86,418	79,679
Tin concentrates (tin content) imported.........	339	137

Nearly all detinning in the United States is done by the electrolytic process or by the chlorine process. Many of the earlier chapters of this series contain data relating to the plants and processes followed, and a complete history of the different methods of detinning is given in an article entitled "Scrap Detinning Affords Big Outlet for Chlorine," by C. L. Mantell, in Chemical and Metallurgical Engineering, August, 1926 (pp. 477–479).

Reports received show that the clean tin-plate scrap detinned in 1927 was 4,106 long tons more than in 1926. The average metallic content of the tin oxide was given as 78 per cent, that of the tin bichloride as 24.5 per cent, tin crystals 52.6 per cent, and tin tetrachloride 45.4 per cent.

The average cost of tin-plate clippings detinned at the plants in 1927 was about $13.32 a long ton, and the average recovery of tin per long ton of clean tin-plate scrap was 32.9 pounds.

The United States in 1927 consumed tin in amount equivalent to more than one-half of the world's output of primary tin in 1927, but the domestic production was only 38 short tons of tin concentrates from Alaska and South Dakota, containing about 27 short tons of tin. The secondary tin recovered in the United States in 1927 was equal to 46 per cent of the tin imported into the United States as pig metal in 1927 (79,679 short tons). The recovery of secondary tin increased from 33,400 short tons, valued at $42,511,500, in 1926 to 36,900 tons, valued at $46,302,100, in 1927. The total value assigned is based on the yearly average price (62.74 cents a pound in 1927) given by the American Metal Market for 99 per cent metal, prompt delivery at New York.

The quantity of secondary pig tin recovered decreased 950 tons. As approximately 1,000 tons (200 tons more than in 1926) of pig tin was recovered in 1927 from scrap tin clippings (not tin plate), old tin pipe, tin foil, and collapsible tubes, the decrease in the output of secondary pig tin was due to the smaller quantity of tin dross and scruff available. The largest recoveries of tin as tin are made from scruff and drosses that occur in making tin and terne plate; these recoveries declined from about 7,200 tons in 1926 to 6,500 tons in 1927. The quantity of tin plate and terneplate made in 1927 (according to the American Iron and Steel Institute) was 1,673,591 long tons, or 108,715 long tons less than in 1926.

The quantity of tin recovered in alloys and chemical compounds in 1927 increased 4,450 tons. Part of this increase was due to the treatment of tin-plate clippings and old cans but most of it to the larger quantity of tin recovered in brass, bronze, solder, babbitt, pewter, and electrotype metal. Some tin was also recovered from waste tin liquors used in dyeing.

New tin-plate clippings were treated at plants of the Vulcan Detinning Co. at Sewaren, N. J., Neville Island, Pa., and Streator, Ill.; by the Johnson & Jennings Co., of Cleveland, Ohio; and at the plants of the Metal & Thermit Co. at San Francisco, Calif., East Chicago, Ind., and Chrome, N. J.

The plants utilizing old tin cans, which can handle 40,000 tons a year, treated only 12,824 long tons in 1927. These plants never received shipments large enough to operate steadily at full capacity, even when the prices of tin and black sheet-metal scrap were high. Most of the old tin-coated containers treated in 1927 were handled at a plant at Los Angeles, Calif., owned by the Metals Refining Co.

The tin reported recovered in alloys and compounds in 1927 included the tin content of products made in several plants from clean tin-plate scrap. The materials recovered included some tin crystals, tin oxide, and putty powder but consisted mainly of tin tetrachloride and tin bichloride. The production of these compounds is stated together in order to avoid disclosing confidential information. As the products are made from scrap tin and thus conserve the primary metal, they are properly regarded as recovered tin.

Tin-plate clippings imported in 1927 amounted to 9,420 short tons, nearly all of which came from Canada. The Philadelphia Sashweight Co. smelted considerable old containers in a cupola to make sash weights; no tin was saved. The copper mines formerly used old cans and miscellaneous iron scrap to precipitate copper from mine waters; baled detinned scrap purchased in California is now used to a large extent. This scrap costs about $20 a ton, and, according to the Utah Copper Co., 1¼ pounds of scrap is used to precipitate 1 pound of copper.

It is estimated that about 27,000 short tons of tin was used in the United States in 1927 by the makers of tin plate and terneplate, whereas the total recovery of secondary tin as metal and in compounds from tin-plate scrap in 1927 was about 3,400 tons.

The following articles, written by E. R. Thews, on the recovery of tin and alloys containing tin are of interest:

Smelting Secondary Tin—the Metallurgical Treatment of Tin Residues: Metal Industry, September, 1927 (pp. 363–365), and October, 1927 (pp. 411–413).

The Production of White Bearing Metals and Tin Solders from Scrap Metals: Metal Industry, September, 1928 (pp. 394–396).

SECONDARY ANTIMONY

Secondary antimony recovered in, primary antimonial lead produced in, and antimony imported into the United States, 1926 and 1927, in short tons

	1926	1927
Secondary antimony in antimonial-lead scrap smelted at regular smelters	2, 550	1, 039
Secondary antimony recovered at secondary smelters	13, 680	11, 361
	16, 230	12, 400
Primary antimonial lead produced at regular smelters	22, 524	24, 347
Antimony content of primary antimonial lead	2, 693	2, 736
Antimony imported in ore, as metal, or as oxide or salts	17, 364	14, 786

The production of secondary antimony in the United States in 1927, most of which was recovered in alloys, aggregated 12,400 tons, a decrease of 23 per cent from the recovery in 1926. The average price of ordinary brands of antimony in 1927, as published by the American Metal Market, was 12.34 cents compared with 15.91 cents in 1926. The regular smelters reported the recovery of 1,039 tons of antimony contained in 9,592 tons of antimonial lead scrap, or 1,511 tons less than they reported in 1926. The recovery of secondary antimony by the secondary smelters also showed a substantial decrease, being more than 2,300 tons below the 1926 output. The imports of antimony in 1927 decreased nearly 2,600 tons, although the quantity of primary antimonial lead made at regular smelters increased more than 1,800 tons.

There was a decrease in the consumption of antimonial lead in batteries in 1927, as the automotive industry made an output much smaller than in 1926 and as probably less antimonial lead was used in radio batteries and in bearing metals. The antimony content of antimonial lead varies from as low as 2 per cent to as high as 20 per cent.

The principal materials refined or remelted that contained antimony as an alloy were hard-lead drosses, babbitt, bearing metal, battery plates, pewter, and type metal. The antimony used in the pigment, paint, and ceramic industries is so dissipated that no secondary recoveries can be made, but a large proportion of the production of metal containing antimony returns in a few months or a few years for refining and reuse. Dealers and brokers return much of the battery plates, and users of bearing metal and type metal regularly ship their used material to the makers of type metal and bearing metal and are credited with its value against the shipments of refined alloys.

The Ford Motor Co. collected battery plates in 1927 and smelted them at two plants. It is stated that this procedure was discontinued in 1928. Most of the old battery plates are collected by dealers and shipped to secondary smelters that buy them at a price based on the price of pig lead at St. Louis. The antimony content is paid for at the price of lead; this price in 1927 was 6.3 cents, or about 6 cents less than the average price of antimony. As antimony is used mainly in an alloy, it is seldom separated in refining scrap.

SECONDARY ALUMINUM

Secondary aluminum recovered in the United States, 1926 and 1927, in short tons

	1926	1927
Secondary aluminum recovered unalloyed	20, 500	23, 000
Aluminum recovered in alloys (mainly No. 12)	23, 700	23, 200
	44, 200	46, 200

Primary aluminum produced in the United States and imported and exported, 1926 and 1927

	1926	1927
Value of primary aluminum produced in the United States	$37, 583, 000	$39, 266, 000
Aluminum (crude and semicrude) imported for consumption pounds	71,391,717	62, 575, 222
Aluminum (crude and semicrude) exported do	7, 634, 171	14, 522, 560

The recovery of secondary aluminum as pig aluminum or in alloys amounted to 46,200 tons in 1927 and was valued at $23,469,600, compared with 44,200 tons, valued at $23,868,000, in 1926.

Some of the larger secondary smelters, refiners, and users of aluminum in 1927 were as follows:

Aluminum Industries Co., Cincinnati, Ohio.
Apex Smelting Co., Chicago, Ill.
Aurora Refining Co., Aurora, Ill.
Bohn Aluminum & Brass Co., Detroit, Mich.
Cleveland Electro Metals Co., Cleveland, Ohio.
Federated Metals Corporation, New York, N. Y.
Ford Motor Co., Detroit, Mich.
General Metals Refining Co., St. Louis, Mo.
Globe Metal Co., Chicago, Ill.
W. F. Jobbins Co. (Inc.), Aurora, Ill.
Lewin Metals Corporation, St. Louis, Mo.
Maytag Manufacturing Co., Newton, Iowa.
Michigan Smelting & Refining Co., Detroit, Mich.
National Bronze & Aluminum Foundry Co., Cleveland, Ohio.
National Smelting Corporation, Cleveland, Ohio.
Niagara Falls Smelting & Refining Co., Buffalo, N. Y.
Oberdorfer Brass Co., Syracuse, N. Y.
Peninsular Smelting & Refining Co., Detroit, Mich.
South Bend Smelting & Refining Co., South Bend, Ind.
United States Aluminum Co., Cleveland, Ohio.
United States Reduction Co., East Chicago, Ind.
Werra Aluminum Foundry Co., Manitowoc, Wis.

A large quantity of No. 12 secondary ingots (92 per cent aluminum and about 8 per cent copper) is made by smelters from old or defective castings, borings, and scrap, but the number of alloys containing aluminum has greatly increased in recent years, and the use of No. 12 alloy is proportionately less than it was.

The scrap and waste aluminum available to foundry users and secondary smelters include chiefly drosses and skimmings, bearings, grindings and similar machining scrap, heavy cast scrap (principally automotive castings), fabricating scrap, and old sheet and utensils. Good clean aluminum scrap is comparatively scarce, and the quantity of dross from the melting of aluminum is small compared with the quantity of drosses and skimmings from aluminum alloys.

In an article, entitled "Secondary Metal Versus Scrap in Aluminum Alloy Foundry Practice," contributed to the American Metal Market, March, 1927, Dr. Robert J. Anderson discusses the virgin character and uses of aluminum scrap and aluminum alloy scrap and its use by foundries as a substitute for primary aluminum or for ingots made by smelters from secondary material. His conclusion is that it is more satisfactory in most instances for a foundry to use purchased ingots made from scrap for the following reasons: The methods for the treatment of aluminum and aluminum alloys have been much improved, so that high-grade secondary casting alloys are being made by reliable smelters that purchase scrap in large quantities; the purchase of miscellaneous scrap direct by the foundry is not as economical as it appears, even when aluminum recovery departments have been installed; the quality of aluminum alloy castings depends upon the metal used; and although good scrap can be bought the foundryman, unless he relies on strict chemical analysis of every lot of scrap purchased, is very apt to use inferior grades of scrap unfitted for his products. For some purposes virgin aluminum should be purchased, but the use of ingot of known analysis made from secondary metal should be encouraged so as to reduce the cost of castings.

The sources of aluminum and aluminum scrap alloys are as follows:

Clippings and sheets from utensils and automobile body works.
Foil, clean or coated.
Cable, clean or dirty.
Castings, pure or unalloyed, classified as (1) clean castings never in use, (2) dirty, reclaimed from machinery, and (3) dirty scrap cleaned.
Bearings, turnings, etc. (machine shops convert 10 to 12 per cent of rough castings into fine particles; their value depends on cleanliness).
Skimmings from melting (they vary widely in metal content).
Grindings and buffings.
Sludge—residue from refining operations, usually worthless.
Dross—aluminous oxide and metal from fluxing operations.

Under normal conditions remelt ingot will sell at about 4 cents a pound below 99 per cent virgin ingot, clippings at 7.5 cents below virgin ingot, clean scrap castings 10 cents below virgin ingot, and borings 15 cents below virgin ingot.

A series of articles relating to aluminum are as follows:

Anderson, Robert J., Smelting Secondary Aluminum and Aluminum Alloys Scrap: Metal Industry, January, 1925 (p. 10); September, 1925 (pp. 368–370); February, 1926 (pp. 63–65); May, 1926 (pp. 187–189); November, 1926 (pp. 455–457); July, 1927 (pp. 281–283); November, 1927 (pp. 452–454); and August, 1928 (pp. 347–349).

SECONDARY NICKEL

Secondary nickel recovered in the United States, 1926 and 1927, in short tons

	1926	1927
Nickel recovered as metal	485	480
Nickel recovered in nonferrous alloys and salts	2,565	2,900
	3,050	3,380

Primary nickel produced in the United States and imported and exported, 1926 and 1927, in short tons

	1926	1927
Nickel produced as a by-product from the electrolytic refining of copper at domestic refineries	323	860
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	22,765	20,489
Nickel, Monel metal, and other alloys exported	799	1,054

The nickel reported as recovered from secondary sources includes nickel in Monel metal (a natural alloy) but not that in ferrous alloys. Although the military use of nickel has declined to less than half its former quantity, the use of nickel in ferrous alloys is still the largest factor of consumption, so it is evident that the 3,380 tons of secondary nickel recovered from nonferrous sources in 1927 forms probably less than half the total recovered and reused. Scrap steel containing nickel is still being recovered from war-time material, and in 1927 at least 1,600 tons of steel, containing about 30 per cent of nickel, from Great Britain was delivered ex ship direct at Chicago docks.

The secondary nickel recovered from nonferrous sources in the United States in 1927 was equal to 16 per cent of the nickel imported; it was recovered mainly as Monel metal, old anodes, nichrome, and nickel silver. The beneficial use of nickel in some brasses and bronzes has been set forth by metallurgists, and its use for such purposes was considerably expanded in 1927.

Analyses of various nickel alloys were published in Mineral Resources, 1915.[7]

Considerable information as to the uses of nickel, Monel metal, and other nickel alloys is given in "Inco," the publication of the International Nickel Co. This company purchases nickel scrap and Monel scrap. A flat offer is made for metal containing not less than 64 per cent of nickel, not less than 27 per cent of copper, not more than 3½ per cent of iron, and not more than 0.05 per cent of sulphur. The scrap must be free from lead and zinc. If the scrap offered is not up to above specification, settlement will be made on a basis of nickel and copper content. As the cost of sampling and analyzing is high, it is necessary to avoid small shipments of scrap, and not less than 500 pounds should be offered for sale.

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[7] Hess, F. L., Nickel: Mineral Resources of the United States, 1915, pt. 1, 1917, pp. 763-765.

RARE METALS

By Frank L. Hess[1]

COBALT

GENERAL CONDITIONS

The United States has produced no cobalt or cobalt ores since 1922, and to supply its needs for the metal or its compounds is wholly dependent on the deposits of Katanga, Queensland, or Canada. Consumption in this country is shown in the long run by imports, though for an individual year some imports may go into stock or drafts may be made on stocks from a previous year.

During the last 10 years imports have been as follows:

Cobalt ore, cobalt, and oxide imported for consumption in the United States, 1918–1927

Year	Ore		Cobalt		Oxide		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1918	(1)	(1)	504, 391	$628, 099	208, 596	$291, 699	712, 987	$919, 798
1919	17, 045	$2, 832	60, 511	141, 450	131, 424	184, 751	208, 980	329, 033
1920	13, 039	4, 794	143, 603	326, 864	202, 724	399, 605	[2] 359, 586	[2] 731, 277
1921	7, 657	3, 235	38, 442	105, 539	164, 003	342, 426	210, 102	451, 200
1922	5, 195	7, 075	126, 364	321, 396	217, 530	435, 895	[3] 349, 089	[3] 764, 366
1923	58, 719	56, 326	225, 639	552, 434	258, 574	511, 903	[3] 542, 932	[3] 1, 120, 663
1924	28, 786	37, 276	118, 952	264, 935	226, 703	440, 898	[3] 374, 441	[3] 743, 109
1925	34, 782	31, 320	198, 669	422, 185	287, 265	546, 292	[3] 520, 716	[3] 999, 797
1926	154, 468	55, 820	387, 076	820, 873	333, 132	632, 478	[2 3] 874, 786	[2 3] 1, 509, 211
1927	60, 382	3, 019	407, 198	841, 442	369, 747	703, 608	[3] 837, 327	[3] 1, 548, 069

[1] Ore included with cobalt, not separately recorded until July, 1918. From July to December, 1918, imports are recorded as follows. Ore, 220,115 pounds, valued at $55,188; metal, 250,920 pounds, $498,316.

[2] Includes 220 pounds of zaffer, valued at $14, in 1920, and 110 pounds, valued at $40, in 1926. Imports of zaffer not separately recorded for 1918, and none imported 1919, 1921 to 1925, and 1927.

[3] Also 11 pounds of "other salts and compounds," valued at $26, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff. Similar additional imports in 1923 were 45,644 pounds, valued at $27,356; in 1924, 797 pounds, $856; in 1925, 13,256 pounds, $7,894; in 1926, 37,342 pounds, $21,647; and in 1927, 55,127 pounds, $28,681.

Cobalt compounds imported for consumption in the United States, 1925–1927

	1925		1926		1927	
	Pounds	Value	Pounds	Value	Pounds	Value
Linoleate	3, 258	$1, 196	2, 522	$952	-------	----------
Sulphate	9, 780	5, 951	34, 466	20, 163	55, 045	$28, 617
Other salts	218	747	354	532	82	64
	13, 256	7, 894	37, 342	21, 647	55, 127	28, 681

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Eoreign and Domestic Commerce.

Cobalt and cobalt ore imported into the United States, 1925–1927, by countries

[General imports]

Country	1925		1926		1927	
	Pounds	Value	Pounds	Value	Pounds	Value
Australia	21,952	$1,413				
Belgium			259,738	$597,496	205,211	$455,799
Canada	178,450	387,413	274,347	264,441	223,291	312,774
Germany	39	85	7,454	14,731	39,078	75,888
Jamaica	500	1,250				
United Kingdom	9,310	19,881				
	210,251	410,042	541,539	876,668	467,580	844,461

During 1927, as in the two preceding years, the Belgian, Canadian, and British operators continued their close control of the supply and price of cobalt. A little cobalt has been imported from Germany, but the quantity was insignificant when compared with other cobalt imports.

The Belgian supply is obtained from veins carrying cobalt, copper, and iron sulphides near Elisabethville, Katanga, Belgian Congo. The ores are reduced in electric furnaces at Panda to an alloy of the three metals containing about 28 per cent of cobalt. The alloy is shipped to the Société Métallurgique de Hoboken, at Oolen, near Hoboken, Belgium, for separation. The firm is a subsidiary of the Union Minière du Haut Katanga, which under various names owns or controls the copper, radium, uranium, tin, cobalt, coal, and other mines and the transportation systems of Katanga.

The Canadian supply is obtained from cobalt arsenides and arsenosulphides accompanying silver in the veins of the Cobalt district, Ontario.

Part of the British supply has been mined from cobalt arsenosulphide veins in the Cloncurry district of Queensland, Australia, principally at Mount Cobalt, where it was found 90 miles south of Cloncurry about 1919; but it has also been found at several other places in the district. There is said to be a promising prospect on Dugald River, 50 miles north of Cloncurry, and a short time ago a lode carrying 40 per cent copper and 17 or 18 per cent cobalt was worked at Loongana, 20 miles south of Cloncurry.[2] The latest available reports from the district have not been encouraging. The remainder of the British supply is saved as a by-product from nickel ores mined near Sudbury, Ontario, and treated by the Mond process at Clydach, Wales.

The small German supply is mined in Saxony and is entered in the official records as "cobalt-bismuth-nickel ores."

About the close of the year the discovery of a cobalt deposit from which a sample showed 20 per cent cobalt was announced from Paris as having been made at Plombières, on the Arpen Plateau.[3] No details are at hand.

In Spain a movement was started during the year to open up the Profunda cobalt deposit near Villamanin, Leon. The property, once owned by D. Ruperto Sanchez, is said to have been bought by an English company 12 or 14 years ago. The Aramo mine at La Saterrana, near Pola de Lena, once worked for cobalt, has not been worked for several years.[4]

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[2] Queensland Government Mining Journal, vol. 34, p. 2, 1928.

[3] Engineering and Mining Journal, vol. 125, p. 31, Jan. 7, 1928.

J. E. Jacobs,[5] United States Consul at Yunnanfu, Yunnan, China, states:

> Cobalt has been mined in Yunnan for many years, as it was extensively used in former times for glazes, having been exported to the famous potteries of Kiangsi Province. Between two and three hundred tons is the present annual output, most of which goes to Kiangsi Province for glazing purposes. It is found principally in the following sections and districts.
>
> *Central section:* Fu Min, Sung Ming, Kun Ming, Cheng Keng, and Ching Ming.
>
> *Northeastern section:* Ping Yi, Sun Tien, Chang Yi, and Hsuan Wei.

Presumably the output is in the form of rather low-grade ore, which is made into smalt or other compounds used in the pottery trade.

The price was held through the year at $2.10 for the black oxide and about $2.50 per pound for the metal, f.o.b. Deloro, Ontario. The London quotations were 8s. for black oxide, 8s. 10d. for gray oxide, and 8s. 6d. to 10s. per pound for metal, equivalent to $1.94, $2.15, and $2.07–$2.43, respectively. These were prices that seemingly could be cut heavily should occasion require; but, like bismuth, cobalt is found in small quantities at many places and in large quantities at very few places, and to control the price and output is comparatively easy.

The chief use of cobalt is in the making of stellite, the corrosion-resistant group of alloys made of cobalt and chromium to which tungsten and other metals are added to adapt the properties to particular needs. Magnet steel, tool steels, and corrosion-resistant steels take other quantities of metallic cobalt. Organic cobalt salts are used for driers in paint, and some cobalt is used as pigment in pottery and enamels.

During the year the Bureau of Standards made tests on the use of cobalt compounds in the treatment of iron plates for enameling, which indicated excellent results from using a water suspension of 2 per cent cobalt oxide.[6]

The Bureau of Standards also studied magnet steels, which during the last few years have absorbed considerable cobalt. Raymond L. Sanford,[7] who conducted the study, comes to the conclusion that:

> 1. The addition of substantial percentages of cobalt to the composition of permanent-magnet steel results in the attainment of coercive-force values from two to five times as great as those of the commonly used tungsten or chromium steels without a serious reduction in residual induction.
>
> 2. On account of the relatively high cost of cobalt, the cobalt steels may be from four to ten times as expensive as the other types of steel. For this reason the element of cost is an important factor in the selection of a magnet steel for a given purpose.
>
> 7. Cobalt steels are superior in quality to tungsten and chromium steels, but this superiority can only be utilized by means of appropriate design. The mere substitution of cobalt steel without change of design will usually lead to disappointing results.

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[4] Channingham, Charles H., U. S. commercial attaché, Madrid, Spain, Letter, Apr. 1, 1927.

[5] Jacobs, J. E., Report to the Department of Commerce, July and August, 1927.

[6] U. S. Bureau of Standards: Tech. News Bull. 127, November, 1927, p. 10.

[7] Sanford, Raymond L., Some Principles Governing the Choice and Utilization of Permanent Magnet Steels: U. S. Bureau of Standards Sci. Paper 567, 1927, pp. 557–567.

9. In general, it may be said that although by the use of cobalt steels some results can be obtained which are utterly impossible with the tungsten and chromium steels more commonly employed, their use is generally not economically justified except in cases where space or weight are of primary importance and cost is a secondary consideration or where particularly severe conditions must be met.

WORLD PRODUCTION

The production of cobalt is given from the several producing countries in such indefinite figures that the estimates are far from exact, but from various official reports the following data have been compiled:

World production of cobalt, 1925–1927, in metric tons

Country	Cobalt-bearing material	1925		1926		1927	
		Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content
Australia: Queensland	Cobaltite concentrates, etc.	417.6	91.4	137.2	27.4		
Belgian Congo	Copper-iron-cobalt alloy	684	[1] 192	794	[2] 360	2,100	[3] 588
Canada: Ontario	Cobalt, alloys, and chemicals	665	246.1	794	302	(4)	398
Chile	Arseno-sulphide ore			6.4	(4)	(4)	(4)
China: Yunnan	(4)	[3] 250	(4)	[3] 250	(4)	[3] 250	(4)
Germany: Saxony	Cobalt-bismuth-nickel ores	145	6.9	155	[3] 7.4	(4)	(4)
New Caledonia	Concentrates [5]					[6] 78.6	[3] 3.5
			472.4		(4)		(4)

[1] Estimated. The Belgian Congo alloy is said to carry 28 per cent of cobalt.
[2] Cobalt in metal, oxide, and salts produced at Oolen, Belgium.
[3] Estimated.
[4] Data not available.
[5] Cobalt-bearing manganese oxide.
[6] Exports.

BIBLIOGRAPHY

Of the literature on cobalt appearing during 1927, which has come to the attention of the U. S. Bureau of Mines, the following articles seem worthy of notice.

Barclay, W. R. Is cobalt an impurity in nickel? Chem. and Met. Eng., vol. 34, 1927, pp. 438 and 581.

A discussion with Robert J. McKay (see references) in which both authors cite many metallurgical facts concerning both cobalt and nickel. Quotes Guillet as showing that cobalt and nickel steels are unlike: "The (commercially) valuable property of the nickel-copper alloys—namely, their silvery whiteness of color—is entirely due to nickel. The decolorizing property of nickel on the colored elementary metals, copper and gold, is almost unique. On copper it begins with relatively small additions and at about 15 per cent of nickel content the characteristic salmon-pink color of copper entirely disappears, and beyond this we get a whole series of white alloys. The effect of cobalt, on the other hand, is entirely different. So far from decolorizing copper, the addition of cobalt even up to 50 per cent makes no appreciable alteration."

Bremhorst, A. Darstellung metallischen Kobalt aus Kobalthaltigen Hüttenrückständen. Metall. u. Erz, vol. 24, 1927, pp. 7-8.

Residues containing 0.5–5 per cent cobalt are roasted alone or with sodium chloride and carbon, or sodium sulphate and carbon, thus converting the cobalt into sulphide. The product is melted and cast into tall molds; it separates into three layers, the lowest of which consists of almost pure cobalt sulphide. On addition of carbon to the charge an alloy containing 90.70 to 94.18 per cent cobalt, 7.60 to 4.20 per cent iron, 0.37 to 0.42 per cent copper, and 1.31 to 0.98 per cent sulphur was obtained.

Clennell, J. E. The estimation of cobalt by the nitrosobetanaphthol method. Min. Mag., London, vol. 36, No. 5, 1927, pp. 270-273.

Corning Glass Works. Glass. British Patent 263,410, July 1, 1926.

Glass, which in plates 4 millimeters thick is transparent to ultra-violet rays, is prepared by reducing the iron present as impurity in the raw materials, preferably to less than 0.055 per cent and melting the materials under nonoxidizing conditions. Titanium impurities are also reduced. In making a calcium phosphate glass raw material is melted with a reducing agent, such as sugar or powdered carborundum, in a crucible free from oxides of iron and titanium. Various coloring oxides, such as those of cobalt, chromium, uranium, vanadium, or nickel, may be added. Fused quartz also may be prepared from material in which the iron and titanium are reduced to a minimum.

Detrez, L. (Metallurgy in Katanga.) Chimie et industrie, Spec. No., May, 1927, pp. 119–139.

A description of the metallurgical treatment of copper, cobalt, and tin ores in Katanga.

Geiss, W., and van Liempt, J. A. M. (The binary system cobalt-tungsten.) Ztschr. Metallkunde, vol. 19, 1927, pp. 113–114.

Hermann, Otto. Thermocouple. U. S. Patent 1637822, August 2, 1927.

The negative element is formed of an alloy of nickel, cobalt, and molybdenum, and the positive element may be formed of a nickel-copper or nickel-copper-cobalt alloy.

Leemans, Joseph. (Some Belgo-Congolese industries.) Chimie et industrie, Spec. No., May, 1927, pp. 87–100.

McKay, Robert J. Practical uses of pure nickel. Am. Electro-chem. Soc. Trans., vol. 52, 1927, pp. 341–345.

Quotes "pure nickel" in the commercial sense, as containing "over 99 per cent of nickel plus cobalt."

———. Is cobalt an impurity in nickel? Chem. and Met. Eng., vol. 34, 1927, p. 438.

Reply to discussion of the preceding article, by W. R. Barclay (see reference). Says that no other two metals are as closely similar as cobalt and nickel.

Masumoto, Hakar. The magnetic, electric, and thermal properties of nickel-cobalt alloys. Sci. Repts. Tôhoku Imp. Univ., vol. 16, 1927, pp. 321–332.

Masumoto, Hakar, and Nara, Sitisaburo. The coefficient of thermal expansion in nickel-cobalt and iron-cobalt alloys, and the magnetostriction of iron-nickel alloys. Sci. Repts. Tôhoku Imp. Univ., vol. 16, 1927, pp. 333–334.

Metal Industry, London. Cobalt in Canada. Vol. 31, pp. 8–9, 1927.

A general article.

Pardo, J. M. El cobalto, sus aplicaciones y yacimientos en España. Ing. y. Construcción, vol. 6, pp. 8–14, January, 1928.

Schiffer, E. (Determination of cobalt and other alloyed elements in cobalt metal, cobalt steel, and high-speed tool alloys.) Stahl u. Eisen, 1927, vol. 47, pp. 1569–1571.

Schulze, Alfred. (Physical properties of cobalt.) Ztschr. tech. Phys., vol. 8, 1927, pp. 365–70.

Sekito, Sinkiti. The lattice constant of metallic cobalt. Sci. Repts. Tôhoku Imp. Univ., vol. 16, 1927, pp. 545–553.

Sevin, R. (The metallurgy and electrometallurgy of cobalt.) Jour. four elec., vol. 36, 1927, pp. 17–19.

A review of the production of cobalt in Canada, New Caledonia, and Belgian Congo, by several methods of metallurgy. Statistics for 1925 on production and consumption in America and Europe are given.

Wilborn, F. (Joint use of cobalt-lead driers.) Farben-Zeit., vol. 31, 1926, pp. 2352–3.

The lack of mechanical strength in films in which cobalt is the sole drier may be compensated by the use of lead drier in conjunction with the cobalt, the extreme rapidity of drying induced by the latter still being evident. A total of 2 per cent cobalt-lead resinate is recommended, distributed according to the drying time and strength of film required.

Wright, W. B., and others. (Geology of Killarney and Kenmare.) Ireland Geol. Surv. Mem., Dublin, 1927, pp. 75–89.

Quote an old account showing that cobalt minerals were at one time found in the Muckross mine, Killarney, Ireland. One miner is said to have shipped 20 tons of ore of unknown richness.

MOLYBDENUM

DOMESTIC PRODUCTION

Molybdenum was mined, concentrated, and sold during 1927 on a considerable scale by two companies in the United States—the Climax Molybdenum Co., at Climax, Colo., and the Molybdenum Corporation of America, at Sulphur Gulch, near Questa, N. Mex. The Santo Niño Mining Co., at Helvetia, Ariz., also sold a quantity of molybdenite.

A total of 216,595 short tons of ore was milled, from which concentrates carrying from 75.14 to 95.4 per cent molybdenum sulphide (MoS_2) equivalent to 2,299,217 pounds of elemental molybdenum, were obtained, an increase of about two-thirds over 1926. Of the total produced, concentrates carrying 2,286,075 pounds of molybdenum, valued at the mines at $1,858,786, were shipped. The output was made principally into calcium molybdate, "molyte" (said to be a compound of calcium, silicon, and molybdenum), and ferromolybdenum. A much smaller part was used in making ammonium molybdate and other chemicals and in making molybdenum wire and sheet.

Except for 1926, the production of molybdenum in the United States during the last 10 years is shown in the following table:

Molybdenum in ore and concentrates, produced in the United States, sold in 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	861,637	$1,253,700	1923	22,667	(1)
1919	297,926	341,814	1924	297,174	(1)
1920	34,900	17,207	1925	1,154,050	[2] $961,324
1921			1926	(3)	(3)
1922			1927	2,286,075	1,858,786

[1] Value not reported.
[2] Estimate by Bureau of Mines.
[3] Bureau of Mines not at liberty to publish figures.

Perhaps the most important event of the year in the molybdenum industry was the announcement that at the beginning of 1928 the price of molybdenum in calcium molybdate would be reduced from $1.20 to 95 cents per pound. The reduction was met by the makers of "molyte." The reasons for the reduction were that the larger sales had allowed mills to be run at more nearly full capacity, with consequent lower costs, and that the lower prices would probably encourage a still larger use.

Near the close of the year the Climax Molybdenum Co. was treating 750 to 800 tons of ore per day, from which between 200 and 230 tons of concentrates containing 80 to 82 per cent MoS_2, or a total 200,000 to 220,000 pounds of molybdenum, were made monthly. By prospecting with diamond drills the company added largely to its known ore reserves, and between 20,000,000 and 25,000,000 tons of ore carrying 0.9 per cent MoS_2 had been blocked out.

The Molybdenum Corporation of America employed a geophysical prospecting firm to examine its holdings, and a rich new vein was found and proved. Indications of a number of other veins were also found, but confirmatory work has not yet been done on them. Late in the year the company took over the Leviathan claim in the Hualpai Mountains, 30 miles southeast of Yucca, Ariz., and the Andy Starr claims, 10 miles west of Tonasket, Wash. The Tonasket deposits have been known for many years but have not heretofore been extensively prospected. The molybdenite is said to be disseminated through granite, forming an ore with a tenor comparable to that of the Climax deposit, in the neighborhood of 1 per cent MoS_2. The Leviathan claim is in Copper Canyon, which drains into Deluge Wash, and during the Great War was worked by the Leviathan Mines Co., of St. Paul, Minn. The claims are located on a quartz vein that probably averages 7 feet in thickness but is 25 feet thick on the 100-foot level, carries molybdenite and chalcopyrite, and cuts biotite granite. The molybdenite and chalcopyrite are later than the vein and were deposited along cracks and faults in the quartz. The vein also carries some pyrite and a little sphalerite and galena. When worked in 1917 the vein was said to carry 2.5 per cent MoS_2 and 1.75 to 2 per cent copper. Both copper concentrate and molybdenum concentrate are made by differential flotation. Water was scarce during former operations, but a better supply is said to have been developed. The ore sold by the Santo Niño Mining Co. is said to have come from a rich pocket.

EXPORTS

The productive capacity of the United States is considerably larger than its present consumption and, indeed, is large enough to more than supply the world's present demands; a considerable quantity of concentrate is shipped to Europe, but the figures have not been kept separately at the customhouses, so that they are not available. According to the Engineering and Mining Journal,[8] the exports in 1927 were about 40 per cent of the production, which would indicate about 450 tons of contained molybdenum.

IMPORTS

The imports since 1918 are shown in the following table:

"*Molybdenum ore*[1] (*steel-hardening*)" *imported for consumption in the United States, 1918–1927*

Year	Pounds	Value	Year	Pounds	Value
1918. July to December[2]	140,222	\$123,924	1923[3]	16,671	\$13,115
1919	106,743	77,572	1924[3]	10,379	9,038
1920	15,639	9,707	1925[3]	1,954	1,793
1921	29,783	20,471	1926[3]	13,397	11,175
1922	412,221	90,015	1927[3]	12,541	10,472

[1] 1918–1922, recorded as molybdenum ore; 1923–1927, recorded as molybdenum content of ore.
[2] Not separately classified prior to July, 1918.
[3] Classification under tariff of Sept. 22, 1922. "Molybdenum ore and concentrates (molybdenum content)."

FOREIGN PRODUCTION

Norway is the principal foreign producer of molybdenum. In 1927 the Knaben mine, northeast of Stavanger, produced almost 156,000 kilos (344,000 pounds) of MoS_2 in the form of concentrates carrying 85 per cent MoS_2, according to a letter from Dr. Jakob Schetelig to the author dated January 24, 1928. It had been the company's intention to produce between 180,000 and 200,000 kilos of MoS_2, but the interruption caused by the installation of new machinery prevented. The concentrates were sold in various European countries. The deposit is molybdenite disseminated along cracks in granite.

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[8] Vol. 125, Mar. 3, 1928, p. 362.

In Canada arrangements were being made in the fall of 1927 to develop a molybdenite deposit owned by the Molybdenite Reduction Co. at Lake Malartic, south of Amos, Quebec.[9]

In Morocco, in the region of Amizmiz, 4 metric tons of molybdenite concentrates were mined by two companies in 1926, but operations were suspended, and it is not known that any work was done by the companies in 1927. In Egypt molybdenite in hexagonal plates 1 inch across and ¼ inch thick was found in quartz veins in the granite mountains about 100 miles east of Kena and 38 miles west of the nearest port on the Red Sea. Some prospecting was done, but no production is known to have been made.

WORLD PRODUCTION

The accompanying table gives the world production of molybdenum in 1926 and such data as are obtainable for 1927. The table has been compiled from available official reports:

World production of molybdenum ores and concentrates, 1926 and 1927

Country [a]	Mineral	Ore	Concentrates	Per cent MoS_2	Contained molybdenum	Value
1926		*Metric tons*	*Metric tons*		*Metric tons*	
Australia:						
New South Wales	Molybdenite	(b)	(c)	(b)	(b)	$199
Victoria	do	(b)	43	84	21.7	35,721
Austria	Wulfenite	(b)	[d]27.4		18.3	(b)
Canada	Molybdenite	(b)	11	83.21	5.5	10,472
Chile	do	208	(b)	(b)	(b)	72
Chosen	do	(b)	41	80	19.7	4,926
Italy	do	(e)	(b)	(b)	(b)	389
Morocco, French	do	(b)	4	(b)	(b)	(b)
Norway	do	(b)	145	80	69.6	129,541
Russia [f]	do	(b)	4	88	2.1	(b)
Sweden	do	(b)	6	83.3	3	5,899
United States	do	(g)	(g)	(g)	(g)	(g)
1927						
Australia: Queensland	do	(b)	1	(b)	(b)	997
Austria	Wulfenite	(b)	[d]13.2		8.8	(b)
Chile	Molybdenite	(b)	(b)	(b)	(b)	(b)
Chosen	do	(b)	(b)	(b)	(b)	(b)
Italy	do	3	(b)	10	.2	309
Norway	do	(b)	156	85	79.6	(b)
Russia [f]	do	(b)	(b)	(b)	(b)	(b)
Sweden	do	(b)	(b)	(b)	(b)	(b)
United States	do	196,491	2,064	84.22	1,043	1,869,700

[a] In addition to the countries listed, Mexico is a producer of molybdenite, but data of output are not available for the years under discussion.
[b] Data not available.
[c] Less than one-half ton.
[d] MoO_3 contained in ores.
[e] One-half ton (500 kilos) reported.
[f] Year ended Sept. 30.
[g] Bureau of Mines not at liberty to publish data.

[9] Mining Journal (London), vol. 159, p. 901, 1927.

USES

In reviewing the molybdenum industry during 1927, and after saying that the use of molybdenum in steel had increased during the year, Phillipson[10] says:

> Molybdenum is now used in steel rarely by itself, but usually in conjunction with chromium in the chrome-molybdenum forging grades of steel; with chromium and nickel in the chrome-nickel-molybdenum types used for such parts as gears and die blocks; and with nickel alone in the nickel-molybdenum case-hardening steels used in the manufacture of roller bearings, differential gears, and other carburized parts. The use of the metal in both steel and iron castings increased somewhat during 1927.

The use of molybdenum in cast iron is thought by some to offer greater possibilities than its use in steel, as the improvement to the iron is said to be greater.

Work has been done on the possible use of molybdenum in making lakes but has apparently not been brought to a conclusion. Manufacturers of lakes buy the carefully roasted concentrate and from it make sodium molybdate. Sodium molybdate is also being used in lithographic inks.

Molybdenum as wire is used to support tungsten filaments in incandescent lamps and as parts in Röntgen tubes.

RESOURCES

At the present price of 95 cents a pound for the molybdenum in calcium molybdate or "molyte" the resources of the United States are large—large, of course, not as compared with iron ore, coal, or similar materials, but large for a metal of which only 0.15 to 0.25 per cent is used in certain steels or cast irons and of which only about 1,200 tons of metal contained in ore per year is produced.

From reports of engineers the Climax (Colorado) deposit seems to contain 150,000 tons of molybdenum and possibly much more. Although the mine in Sulphur Gulch, near Questa, N. Mex., has at no time had large reserves in sight, it has yielded a considerable supply for six years or more and is said to have shown better ore recently than ever before. The mine on Shakan Peninsula, Alaska, has some thousands of tons of developed ore comparable with that at Climax, and, as already stated, the Andy Starr claims near Loomis, Wash., seem to be of about the same tenor. Many smaller deposits at various places in the United States combine to make a total probably amounting to more than the quantity at Climax, though possibly not so readily or cheaply mined because in much smaller bodies.

NICKEL

DOMESTIC PRODUCTION

As has been noted frequently, the United States possesses no nickel deposits of sufficient size and richness to compete with the deposits now worked in Ontario, and it probably could not produce enough nickel to supply its present demands if the price were doubled or even trebled.

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[10] Phillipson, B. F., Molybdenum: Eng. and Min. Jour., vol. 125, 1928, p. 105.

The only nickel now produced in this country is a small quantity saved as nickel salts in the electrolytic refining of blister copper. The blister copper made from sulphide ores carries minute quantities of nickel which accumulate in the electrolyte of the electrolytic refineries and are finally obtained from it as hydrous nickel sulphate ($NiSO_4.7H_2O$), known in the nickel-plating industry as "single salt," or hydrous nickel-ammonium sulphate ($NiSO_4.(NH_4)_2SO_4.6H_2O$), known as "double salt."

In 1927 three companies saved 6,534,722 pounds of the two salts containing, together with a quantity of nickel saved as such, a total of 1,719,518 pounds of nickel, valued at $390,740. The domestic production of nickel during the last 10 years is shown in the accompanying table:

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1918–1927, and from mixed ores in 1919 and 1920

Year	Short tons	Value	Year	Short tons	Value
1918	441	$401,000	1923	100	$71,605
1919[1]	511	434,485	1924	191	114,903
1920[1]	365	293,250	1925	272	169,664
1921	111	86,000	1926	323	234,558
1922	208	133,191	1927	860	390,740

[1] Including nickel produced from copper-lead-cobalt-nickel ores mined in Missouri.

PRICES

According to quotations in the Engineering and Mining Journal during 1927 ingot nickel sold at 35 cents, shot nickel at 36 cents, and electrolytic nickel at 39 cents per pound.

The actual price received by one large nickel company, as shown by dividing the gross amount received by the quantity of nickel sold, has been as follows:

Average prices of nickel and Monel metal, 1913–1927, in cents per pound

Period ended—	Metallic nickel	Electrolytic nickel	Monel metal	Period ended—	Metallic nickel	Electrolytic nickel	Monel metal
Mar. 31, 1913	28.22	41.16	21.17	Mar. 31, 1921	39.32	42.04	41.41
Mar. 31, 1914	28.03	41.37	22.13	Mar. 31, 1922	34.17	38.25	44.50
Mar. 31, 1915	28.50	41.32	20.65	Mar. 31, 1923	29.63	35.48	42.35
Mar. 31, 1916	31.76	41.85	23.74	Mar. 31, 1924	24.66	30.33	42.18
Mar. 31, 1917	32.50	41.52	29.67	Mar. 31, 1925	26.98	28.83	43.25
Mar. 31, 1918	36.74	40.82	37.22	Dec. 31, 1925	29.24	32.79	43.62
Mar. 31, 1919	36.20	40.41	39.29	Dec. 31, 1926	31.65	35.63	44.45
Mar. 31, 1920	37.35	42.32	40.59	Dec. 31, 1927	31.81	35.43	43.41

SECONDARY NICKEL

Figures collected by John P. Dunlop show the production of secondary nickel—that is, nickel recovered after being used—to have been as follows during the last seven years:

Secondary nickel recovered as metal and in nonferrous alloys and salts in the United States, 1921–1927, in short tons

Year	Nickel recovered			Year	Nickel recovered		
	As metal	In nonferrous alloys and salts	Total		As metal	In nonferrous alloys and salts	Total
1921	86	859	945	1925	191	2,109	2,300
1922	104	1,408	1,512	1926	485	2,565	3,050
1923	177	1,373	1,550	1927	480	2,900	3,380
1924	114	2,126	2,240				

IMPORTS AND EXPORTS

Value of nickel imported for consumption in the United States, 1918–1927

Year	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.	Manufactures and nickel sheets and strips	Total value	Year	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.	Manufactures and nickel sheets and strips	Total value
1918	$11,520,826	$115,243	$11,636,069	1923	$6,602,096	$94,832	$6,696,928
1919	8,334,564	90,451	8,425,015	1924	6,132,984	70,755	6,203,739
1920	10,657,523	200,464	10,857,987	1925	7,772,320	98,761	7,871,081
1921	1,220,347	107,155	1,327,502	1926	9,409,567	65,166	9,474,733
1922	3,945,309	110,176	4,055,485	1927	8,802,075	111,816	8,913,891

Nickel imported for consumption in the United States, 1925–1927, by classes

Class	1925		1926		1927	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	9,912,145	$1,062,844	14,635,651	$1,303,003	10,744,474	$902,272
Nickel alloys, pigs, bars, etc	31,876,710	6,532,495	29,408,950	7,865,493	29,219,779	7,720,885
Nickel oxide	1,282,218	176,981	1,485,386	241,071	1,013,332	178,803
Nickel silver or German silver	------	----------	----------	----------	232	115
Manufactured:						
Nickel silver or German silver in sheets, strips, and rods	7,565	4,369	6,476	4,743	16,522	12,047
All other manufactures of nickel	123,681	94,392	42,293	60,423	----------	99,769
	----------	7,871,081	----------	9,474,733	----------	8,913,891

Nickel exported from the United States, 1925–1927, by classes

Class	1925		1926		1927	
	Pounds	Value	Pounds	Value	Pounds	Value
Nickel Monel metal and other alloys	2,569,185	$834,529	1,598,538	$428,820	2,108,435	$601,182
Manufactures	529,906	360,628	(1)	575,048	(1)	787,767
Nickel silver or German silver in bars, rods, or sheets	492,964	135,906	1,539,480	336,265	1,424,268	319,059

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[1] Quantity not recorded.

The United States receives some nickel from New Caledonia, a French island in the south Pacific Ocean, where the metal is found as hydrous nickel-magnesium silicate of two types, known as garnierite and noumeite. Both are varieties of genthite. The New Caledonian nickel is handled by the United States Nickel Co., which has a plant for the reduction of matte at New Brunswick, N. J., and is a subsidiary of the Société des Hauts-Fourneaux de Nouméa, Paris, France. The matte is smelted from the ore by the Usines de Nickel de la Nèthe, which is closely connected with the French company and has a plant on the river Nèthe between Antwerp and Malines. However, by far the larger part of the nickel used in the United States, as in the rest of the world, comes from Sudbury, Ontario. Two companies mine virtually all of the nickel produced in Canada—the International Nickel Co. (the main office of which is at 67 Wall Street, New York, N. Y.) and the Mond Nickel Co. (Ltd.) (the head office of which is at 39 Victoria Street, London, SW. 1, England). The latter company has a branch, known as the American Mond Nickel Co., at Clearfield, Pa. The International Nickel Co. is much the largest concern in the nickel business.

CANADIAN PRODUCTION

Concerning the Canadian production of nickel, Rogers and Young say:[11]

> During 1927 ore raised and shipped to the nickel-copper smelters amounted to 1,305,917 tons. Matte resulting from the treatment of 1,350,214 tons of ore amounted to 81,848 tons, of which 73,483 were shipped to the refineries, 53 per cent or 39,942 tons going to Port Colborne and the balance to Swansea, Wales. The refinery of the International Nickel Co., which operated steadily throughout the period, produced 28,469,996 pounds of refined nickel, 22,656,720 pounds of converter copper, and 8,478,963 pounds of nickel oxide. In addition, recoveries of gold, silver, and metals of the platinum group were made.
>
> The activity in this major industry noted in 1926 was well maintained during the year. A total of six mines were in operation throughout the period, namely, Creighton and Frood by the International Company; and Levack, Garson, Worthington, and Frood Extension by the Mond. A feature which is receiving wide attention throughout the mining world is the important development now under way at the New Frood mine of the International Nickel Co. and the neighboring Frood Extension of the Mond. An immense deposit of high-grade copper-nickel ore running as high as 20 per cent copper and with the usual nickel content has been proved, and the sinking of deep shafts on both properties is now well advanced. It will be two or three years, however, before production may be expected.
>
> The table following gives the record of mining and smelting operations for the last pre-war year, for the year of maximum output, and for the past four years:

Schedule	1913	1918	1924	1925	1926	1927
Ore raised tons	784,697	1,643,040	1,411,980	1,264,748	1,322,050	1,305,917
Ore smelted do	823,403	1,559,892	1,307,694	1,258,849	1,309,782	1,350,214
Bessemer matte produced do	47,150	87,184	65,943	70,280	78,643	81,848
Nickel content of matte do	24,838	45,886	34,638	36,596	39,038	39,623
Copper content of matte do	12,938	23,843	18,490	19,636	24,159	25,969
Matte exported do	----------	----------	26,565	32,397	34,908	33,541
Matte refined in Canada[a] do	----------	5,334	37,613	38,567	33,489	39,942

[a] Refining in Canada began at Port Colborne, Ontario, in 1918, and at Deschênes, Quebec, in 1920. The plant at the latter place closed down in July, 1924.

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[11] Rogers, W. R., and Young, A. C., Preliminary Report of the Mineral Production of Ontario in 1927: Ontario Dept. Mines Bull. 64, Toronto, 1928, pp. 17-18.

Nickel-copper refining, 1926–27

Schedule	1926	1927
Matte treated ……tons	33,489	39,253
Nickel oxide marketed ……pounds	7,644,808	8,478,963
Metallic nickel recovered ……do	25,627,602	28,469,996
Blister copper recovered ……do	18,505,324	22,656,720
Gold recovered[1] ……ounces	4,447	4,866
Silver recovered[1] ……do	151,429	188,180
Platinum metals recovered[1] ……do	19,495	22,762

[1] Includes recoveries by the Mond Nickel Co. at Clydach in Wales.

Details regarding precious metals recovered during a 5-year period by nickel-copper refineries treating Ontario nickel-copper matte are noted in the table below:

	1923, ounces	1924, ounces	1925, ounces	1926, ounces	1927	
					Ounces	Value
1. Gold[1]	3,574	4,125	4,016	4,447	4,866	$99,908
2. Silver	100,982	122,889	134,390	151,429	188,180	105,759
3. Platinum	6,810	9,181	8,692	9,471	11,217	716,653
4. Palladium	8,511	8,923	7,856	9,790	11,247	541,319
5. Rhodium, ruthenium, osmium, and iridium	304	593	432	234	298	12,871
Total platinum metals	15,625	18,697	16,980	19,495	22,762	1,270,843

[1] Includes small recoveries of group 5 by the Mond Nickel Co.

The recovery in precious metals alone is enough to make the mines notable. It comprises 7.4 tons, worth $1,476,510, of which three-fourths of a ton consisted of metals of the platinum group.

The discovery by diamond drilling of the nickel-copper ore very rich in copper at a depth of about 3,000 feet in the New Frood mine of the International Nickel Co. became known in April.[12] The ore body is apparently large and extends under the adjoining Mond Nickel Co.'s Frood Extension.

The Mond Nickel Co.'s Worthington mine collapsed on the morning of October 4, "wrecking hundreds of yards of the Canadian Pacific Railroad and engulfing the railway station."[13] The railway shops and roundhouse were badly damaged. Rumblings preceding the collapse gave ample warning, so that all escaped and there were no fatalities. The mine was 1,200 feet deep and had been worked on a considerable scale for 17 years. When the final collapse came, the jar was felt for miles.

At the thirteenth annual general meeting of the Mond Nickel Co., held in London and reported in the Northern Miner for August 4, 1927, the president, Sir Alfred Mond, stated that the company's ore reserves were sufficient for 40 or 45 years. In spite of increased wages and other expenses amounting to 66 per cent above pre-war costs, the company is by magnetic separation of the ore able to produce matte at the lowest cost in its history. At 2,000 feet depth its Frood mine was producing better ore than at higher levels. The president also reported that the company's sales of nickel in the United States had doubled in two years.

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[12] Engineering and Mining Journal, vol. 123, 1927, p. 740.

[13] Mining Journal, London, vol. 159, 1927, p. 812.

The International Nickel Co., at a cost of $750,000, completed an addition to its electric refinery at Port Colborne, Ontario. The plant is expected to turn out annually 6,000 tons of nickel carrying 99.9 per cent Ni.[14]

WORLD PRODUCTION

The world production of nickel, as nearly as can be ascertained from various Government reports, is shown in the table following. Although some of the figures are merely approximate, the quantities they represent are not sufficient to make the errors serious.

World production of nickel, 1926 and 1927, in metric tons

Country	1926				1927			
	Ore		Matte		Ore		Matte	
	Total	Nickel content	Total	Nickel content	Total	Nickel content	Total	Nickel content
Canada	[1] 1,188,208	(2)	71,343	35,414	[1] 1,224,887	(2)	74,251	35,945
Germany: Saxony	[3] 155	(2)			(2)	(2)	(2)	(2)
Greece	(4)	(4)			(2)	(2)	(2)	(2)
New Caledonia	100,364	5,269	5,039	3,880	118,000	5,900	4,428	3,410
United States[5]			1,370	293			2,998	780

[1] Ore smelted.

[2] Data not available.

[3] Cobalt-bismuth-nickel ore.

[4] In 1926, 10,736 tons of ore was shipped from stocks carried over from 1919. The average content is reported as 5.5 per cent Ni. No production has been recorded since 1919.

[5] Hydrous nickel sulphate and nickel-ammonium sulphate.

TANTALUM

GENERAL

Like all of the rare metals, its very rarity gives tantalum a touch of mystery that makes it attractive to many; but like the other rare metals, not including the precious metals, its sources, uses, and markets are very limited. Should an unforeseen and unexpectedly large supply of ore become available, it is not likely that the demand would increase in proportion; in fact, the price would probably fall unless the supply were closely controlled.

The isolation of tantalum from its ores is so difficult and the demand for the metal is so small that only two firms are known to extract the metal from its minerals—the Fansteel Products Co., North Chicago, Ill., and the Siemens & Halske A. G., Charlottenburg, Germany.

Tantalum is found in comparatively few minerals and under narrow geologic conditions. It is one of a pair of metals that are unknown separately, although columbium, the other member of the pair (called niobium by many Europeans, although the name columbium has priority), is sometimes reported alone in minerals. The metals are very difficult to separate, possibly more so, excepting zirconium and hafnium, than any other pair of closely associated metals, such as gold and silver, rubidium and cesium, uranium and thorium, and the rare earth metals, and no method of clean, perfect separation is known. Tantalum and columbium are ordinarily separated by precipitating them as potassium fluorine salts. The tantalum salt begins to precipitate before the columbium salt, but before the tantalum salt has all precipitated the columbium salt begins to fall. The salts form crystals readily distinguished, and as soon as columbium salts begin to come down the operation must be stopped in order to save the tantalum from serious contamination. The remainder of the tantalum comes down with the columbium. It follows that the greater the quantity of columbium present the smaller the proportionate quantity of tantalum that can be recovered and the larger the proportionate quantity of chemicals and labor required, so that manufacturers naturally must buy the highest grade minerals available. This difficulty of separation, together with the great avidity of hot tantalum for carbon and the common gases, makes the isolation of tantalum extremely difficult. Many metals can be reduced from their oxides by hot carbon monoxide (CO) or hydrogen, but tantalum combines with either. It also combines with oxygen and nitrogen.

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[14] Industrial and Engineering Chemistry, News edition: Apr. 10, 1927, p. 6.

The tantalum minerals have been found exclusively in pegmatites or in deposits closely related to the pegmatites, and outside the real pegmatites the deposits amount to little. Columbite has been described as being found with the Cornish tin ores.[15]

Wolframites, such as those of Cave Creek, Ariz., and Pioche, Nev., may carry as much as 2 per cent tantalum and columbium oxides, and cassiterite may also carry a small percentage. But so far the only tantalum minerals of consequence as a source of the metal are the strictly pegmatitic minerals, and they are found only in those pegmatites in which, in the opinion of the writer, replacements have proceeded to the stage of albitization, although some pegmatites are said to contain oligoclase in place of albite.

Although there is a fairly long list of tantalum minerals few are of importance. Columbite is by far the most common and the most important; it is a very variable tantalate and columbate of iron and manganese, which may contain almost no tantalum or almost no columbium. If the quantity of columbium is very small, the mineral is known as tantalite. The content of iron and manganese may also vary. If a tantalite contains almost no manganese, it is dense black and is called tapiolite (also known as skogbolite); if manganese is present to the almost total exclusion of iron, the mineral is a beautiful translucent red and is called manganotantalite. Antimony or calcium (lime) may be present almost to the exclusion of manganese and iron, and the minerals are then known as stibiotantalite and calciotantalite, respectively. The elements listed above are only the principal elements occurring in these minerals. All the tantalum-columbium minerals contain small quantities of other elements. The Noddacks[16] describe a Norwegian columbite which contained at least 38 elements, largely, however, in quantities determinable only by spectrographic means. Berzelius[17] describes a tantalite carrying

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[15] Holloway, George T., The Relation Between the Mineral and Chemical Industries: Jour. Soc. Chem. Ind., London, vol. 29, 1910, pp. 53-62.

[16] Noddack, Walter, and Noddack, Ida, Recent Investigations of the Elements Masurium and Rhenium: Continental Met. and Chem. Eng., vol. 1, 1926, pp. 109-111.

[17] Gahn, J. Gottlieb, and Berzelius, J., Untersuchungen einiger in der Nähe von Fahlun gefunden Fossilien: Jour. Chem. Phys. Schweigger, Dr. J. S. C., vol. 16, 1816, p. 241.

16.75 per cent tin oxide (SnO_2) and another carrying 6.12 per cent tungsten trioxide (WO_3).

As has been intimated, the columbites are found in those places where pegmatites outcrop. On the other hand, comparatively few pegmatites carry any considerable quantity of the tantalum-columbium minerals. Likewise, although the largest quantities of tantalum-columbium minerals are found with lithium minerals, most lithium-bearing pegmatites carry only small quantities of tantalum-columbium minerals. The greatest source so far found is in the pegmatites of Western Australia and here, too, have been found the greatest number of tantalites—tantalite, manganotantalite, calciotantalite, stibiotantalite, and tapiolite.

TANTALUM IN WESTERN AUSTRALIA

Simpson[18] has described the deposits as he saw them in 1927. His article may be digested thus:

The Pilbara gold field is in the northwest part of Western Australia. It has coastal steamer service and the Perth-Derby air mail service. A railway 114 miles long runs from Port Hedland to Marble Bar in the middle of the gold field. Properties at Mud Springs, Tabba, and Wodgina are actively mined. At Mud Springs (Moolyella, a few miles northeast of Marble Bar) Ellis and Maher are mining "alluvium," which is crushed and concentrated. It consists of 3 feet of "wash," made up of "ferruginous clay and gravelly quartz and felspar (microcline)." Above is 3 to 6 feet of "overburden," which is removed by tractor and scoop.

A tin concentrate (purposely incompletely dressed) contained 90.1 per cent cassiterite, with 1.5 per cent manganocolumbite, 8.3 per cent spessartite (manganese garnet), and traces of zircon, magnetite, monazite and epidote. With care it could be dressed up to 70 per cent metallic tin. About two-thirds of the concentrate was finer than 10 mesh.

In Moolyella gully there is a small patch of alluvium, at the bottom of which is 2 to 3 feet of microcline quartz gravel "cemented with sand and tough green clay." Most of the first concentrates carry spessartite (specific gravity 4.2), some monazite (specific gravity 5.3), and manganocolumbite (specific gravity 5.7), besides cassiterite. The country rock is granite cut by thousands of pegmatites, only a few of which appear to carry visible cassiterite. Water is scarce.

The Tabba Tabba tin and tantalum field is about 8 miles southwest of the 35-mile post on the Marble Bar Railway. It appears to be very small and has been proved over an area of less than 4 square miles. The country rock is epidiorite, with granite close by on the west and south. No tantalite was observed in the principal workings, but at Tabba, Thelemann's M. L. 317, are at least two parallel pegmatites which have shed abundant gravelly tantalite on the gentle slopes. Only this detrital ore is now being worked. Dry concentration by hand sieving is used. "The soil is nowhere more than a foot or two thick, but tantalite can be obtained from almost every square yard of the lease." On Young and Moulden's M. L. 312 there is a prominent pegmatite "vein," up to 40 feet wide in places, bearing northwest. Soft detritus alongside this vein is being partly concentrated for tantalite by sieving, and the concentrates, running about 10 per cent tantalite, are being carted to Wodgina (58 miles) for final dressing.

There are three good wells close to the leases at Tabba, and abundant water is available from them at 40 feet for machine crushing and concentration but not for any large-scale sluicing. The old and new tantalite prospects on Strelling Station, north of the railway between the 30 and 35 mile posts, were not visited.

Wodgina has been long deserted, but mining for tantalite and prospecting for it and tin are now being prosecuted. Young and Moulden are opening up the old pegmatite through almost the whole length of M. L. 86 and 87. They have a small plant consisting of crusher, jigs, and table. High-grade tantalite is recovered, some from the soil on the slope below the outcrop and some from the lode. Concentrates are made at the rate of 20 to 30 tons per annum and are sold at about £200 per ton. They are almost clean manganotantalite, with a little spessartite and a few pebbles of scheelite. They seem to be free from cassiterite. The main vein runs north-south and a little beyond the leases in both directions. It is mainly coarsely crystallized albite, with irregularly distributed bunches of quartz, microcline, and lepidolite and many small crystals of spessartite. Associated with the tantalite at the northern end are small quantities of mackintoshite, thorogummite, pilbarite, and hydrothorite, large masses of lithiophilite (8 to 9 per cent Li_2O), masses in the workings and in the dumps ranging from 1 to 300 pounds, and small veins and larger masses of apatite. A dump shows large masses of white beryl. In a coarse vein at the north end is a large mass of lepidolite, and smaller masses are scattered along the main vein. Near the middle there is 4 or 5 feet of coarse albite on each side of a barren granite horse 20 feet thick. At this place tantalite in lumps weighing 1 to 5 pounds stud the albite thickly. Float tantalite shows on the surface of the leases from one end to the other, although 70 tons was obtained from the surface many years ago. The mineral from the vein is remarkably uniform in grade and averages Ta_2O_5 68 per cent, Sb_2O_5 14 per cent, MnO 13 per cent, and FeO 2 per cent. Buyers want none under 63 per cent Ta_2O_5. The Mount Cassiterite mine, M. L. 84, has SnO_2 in the chlorite-biotite schist alongside the pegmatite. On one dump spodumene is rather common. There is very little alluvial ground in the Wodgina area.

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[18] Simpson, Edward S., Pilbara Tin and Tantalum Deposits: West. Australia Chem. Eng. and Min. Rev. (Melbourne), vol. 20, 1927, pp. 83-87; 1 sketch map.

Mount Francisco is 16 miles south-southwest of Wodgina, but 33 miles by road. Four miles east of Francisco well is Hooley's columbite lode. It is an east-west pegmatite, principally albite with quartz, microcline, and in places muscovite and lepidolite. Beryl is common in crystals ranging from a few ounces to 50 pounds. Manganocolumbite is abundant in the vein and in the surrounding soil. Several tons of pebbly ore (¼ inch to 3 inches) could be easily collected on the surface, but the clean concentrate carries an average of only 22 per cent Ta_2O_5 and 58.2 per cent Cb_2O_5. The minimum is 13.7 per cent Ta_2O_5 with 65.9 per cent Cb_2O_5 and the maximum, 44.7 per cent Ta_2O_5 with 37.1 per cent Cb_2O_5. No SnO_2 was seen. The country rock is granite. Five miles south of Francisco well G. J. Hooley has discovered float cassiterite in considerable quantity. Good prospects (2 to 3 ounces from 10 pounds) have been obtained in the soil along the outcrops of two east-west pegmatites. The concentrates carry a little monazite and euxenite. A basic dike not far away contains ceylonite.

In some of the workings at Cooglegong cassiterite with "gravelly monazite" is found. An analysis showed 4.5 per cent ThO_2 and 55 to 65 per cent Ce_2O_3. Three tons of gadolinite were found in a pegmatite 4 miles east of the Cooglegong Hotel and a half mile west of Black Ridge. None is now visible in the pegmatite, but gravel from a dry stream bed gave cassiterite 30 per cent, gadolinite 30 per cent, magnetite 25 per cent, fergusonite 10 per cent, and monazite, garnet, and limonite 5 per cent.

During 1927 Western Australia exported 17 long tons of tantalum minerals, valued at £3,746.

One and one half hundredweights (168 pounds) of tantalite, valued at £8, was produced in the Territory of North Australia during the fiscal year ended June 30, 1927. This is the first output of the mineral reported from this Territory.[19]

In southern Africa columbite has been found at many places, and that region seems to hold out possibilities of future production.

DOMESTIC PRODUCTION

The second largest source of columbite has been in the Black Hills of South Dakota. Various pegmatites, particularly the Peerless, Ingersoll, and Etta, all near Keystone, have produced some tons of columbite, but in neither the quantity nor quality of the Western Australia pegmatites.

During 1927 approximately 1,100 pounds of columbite was produced carrying about 45 per cent Ta_2O_5 and 75 per cent combined

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[19] Reports on the Administration of the Territory of North Australia, 1927, Canberra, 1927.

Ta_2O_5 and Cb_2O_5 from the Peerless, Hugo, and other claims. It sold for $378.

The production during the past 10 years has been:

Columbite, mined in the United States, shipped in 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	4,500	$2,250	1923	1,350	$540
1919	300	90	1924	1,197	598
1920	4,000	1,450	1925	------	------
1921	3,400	1,150	1926	2,100	650
1922	600	240	1927	1,100	378

In the fall the Black Hills Tin Co. at Tinton in the northern Black Hills discovered shoots of columbite in the tin-bearing pegmatite which has attracted attention periodically for nearly 50 years. Columbite with stream tin (cassiterite) had been sluiced from the gravels of Bear Creek but had never been found in place except as specimens. Mining began about the end of the year. As usual, the columbite is found with albite, and after the discovery of columbite the lithium minerals spodumene and lithiophilite were found. Lithium minerals had never before been found in the northern Black Hills.

The pegmatite in which the minerals were found is peculiar in that it was originally, at least in large part, a great quartz vein lying parallel to the schistosity of a mica-quartz schist. Movement along the schistosity sheeted the quartz vein, and solutions carrying pegmatitic minerals or the elements contained in them replaced the quartz along the sheeting cracks, making possible shoots of tin ore hitherto unknown in pegmatites. The columbite is said also to be in shoots but to cross the sheeting. However, the writer could not verify this statement when on the ground.

Columbite has been found in Maine, the Carolinas, Virginia, Georgia, Alabama, New Mexico, Texas, Colorado, and California, but is generally high in columbium and in small quantity. Specimens of real tantalite have been found in Georgia and South Dakota.

USES

The uses of tantalum are comparatively few. Its first use was as a filament in electric lamps, but tungsten was soon applied to the same use and was so much better, owing to its higher melting point, electrical behavior, ease of working, and abundance, that it promptly superseded the rarer metal. Tantalum has an electrolytic valve action; that is, it will allow an electric current to flow only one way,[20] and with the growth of the radio business a great demand was created for tantalum to be used in chargers for storage batteries patented and made by the Fansteel Products Co.,[21] North Chicago, Ill. But here, again, it has been superseded by an adapter that could be screwed into an ordinary incandescent lamp socket, doing away with storage batteries. Tantalum-lead cells have been used to protect men from accidental contact with high voltages.[22]

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[20] Gunther-Schulze, A., Electrolytic Valve Action; the Polarization Capacity of Ta: Ztschr. Physik, vol. 6, 1921, pp. 237-247.

[21] Fansteel Products Co. (Inc.), Electrolytic Rectifier: British Patent 235658, Mar. 22, 1924.

[22] Stryker, C. E., Electrolytic Cell Protects Against High Voltages (The tantalum-lead cell): Electrical World, vol. 89, 1927, p. 611.

During the year Bishop & Co., of Malvern, Pa., began the manufacture and sale of tantalum dishes for chemical ware and cathodes for the electrolytic determination of copper and other metals. Although tantalum objects can not be heated in the air to anything approaching red heat without being destroyed by oxidation, when cold the metal is not attacked by boiling hydrochloric, nitric, or sulphuric acid, by aqua regia, or by alkaline solutions. It is attacked solely by hydrofluoric acid. Heated in the air it takes a yellow tint at 400° C. and a dark blue tone if exposed for some time at about 500° C. or for a shorter time at 600° C.[23] Objects of art are made in this way.

The use of tantalum for making pens was patented by Siemens & Halske A. G.[24]

Loewe[25] has patented the use of tantalum, nickel, tungsten, or molybdenum alloyed with a slight quantity of magnesium or calcium for making the anodes of a Röntgen-ray tube. By this method the anode metal is exposed to a vapor of magnesium or calcium and will thereafter give off minute quantities when heated in the bulb in a high vacuum, thus improving the electrode emission without coating the wall of the bulb sufficiently to cut off transparency.

An alloy of tantalum and nickel for making instruments and parts of chemical apparatus, resistant to chemicals and oxidation, was patented by Siemens & Halske[26] in 1913. The alloy contains 5 to 30 per cent of tantalum. The alloy with the highest percentage is said to resist heating in aqua regia for a long time without undergoing change. It is said to be very tough, easily hammered and drawn, and has a breaking strength "which decidedly surpasses that of the best steel." The alloys can be heated to a high temperature in air without oxidation.

An alloy steel adapted for high-speed tools and having a content of 16 to 20 per cent tungsten, 2.5 to 5 per cent chromium and 1 to 3 per cent tantalum and columbium has been patented by P. M. McKenna.[27] He also patented another alloy steel,[28] which contains besides iron not less than 0.20 per cent carbon, 0.70 to 1.60 per cent chromium, and 1 to 3 per cent tantalum for use in springs, saws, or gun barrels.

A. Pacz[29] has patented the use of tungsten into which has been introduced a compound or compounds containing an oxide of tantalum or columbium or both for incandescent lamp filaments which are said to be substantially nonsagging and nonoffsetting.

An alloy of tantalum and aluminum which corresponds to the formula Al_3Ta and which is said to be not acted upon by any single acid except hydrofluoric acid and not oxidized below white heat has been described by W. H. Chapin.[30]

The price of tantalum is about $200 per kilo.

No imports of tantalum or tantalum ores were recorded for 1918, 1919, 1922, or 1924. For other years in the decade 1918 to 1927 imports have been recorded as follows: 1920, 60 pounds of "ferro-alloys (tantalum)," valued at $54; 1921, 1,229 pounds of "ferro-alloys (tantalum)," $788, and 6,785 pounds of "steel-hardening ores (tantalum)," $1,327. Beginning with 1923 the classification is "Ores of ferro-alloying metals (tantalum)," and the figures are as follows: 1923, 5,600 pounds, $3,031; 1925, 5,022 pounds, $1,347; 1926, 350 pounds, $149; 1927, 15,119 pounds, $20,012.

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[23] Von Bolton, W., and Feuerlein, O., Die Tantallampe, eine neue Glühlampe der Firma, Siemens & Halske A. G.: Elektrotech. Zeit., Berlin. Jan. 26, 1905, pp. 107 and 109.

[24] Siemens & Halske A. G.: British Patent 3691B, 1905.

[25] Loewe, S., Vacuum and Röntgen-Ray Tubes British Patent 257601, Aug. 25, 1925.

[26] Siemens & Halske A. G., Process for Improving the Mechanical and Chemical Resistance of Nickel: German Patent 277242, Mar. 4, 1913.

[27] McKenna, P. M., Alloy Steel: U. S. Patent 1389679, Sept. 6, 1921.

[28] McKenna, P. M., — —: U. S. Patent 1389680, Sept. 6, 1921.

[29] Pacz, A., Tungsten Filaments: U. S. Patent 1508241, Sept. 9, 1924.

[30] Chapin, W. H., A Tantalide of Aluminum: Abstract in Science, vol. 57, 1923, p. 567.

An incident of probable importance was the isolation during the year of columbium at the Fansteel Products Co.'s laboratories in North Chicago, Ill., by Dr. C. W. Balke and his coworkers. The isolation of columbium is much more difficult than even that of tantalum, and Doctor Balke says, in a communication to the author, that the newer metal has characteristics which may make it of real value.

In the appended references are shown proposed uses, methods of isolation, and recent literature on tantalum.

BIBLIOGRAPHY

The following articles are among those on tantalum which appeared or became available during 1927:

Brace, Porter H. Alloy of tantalum. U. S. Patent 1588518, June 15, 1926.

Patents an alloy claimed to be resistant to acids and oxidation, containing 5 to 30 per cent chromium, the remainder being tantalum and nickel in the proportions of 1 to 75 per cent nickel, and 25 to 99 per cent tantalum. Cobalt may be used in place of nickel, molybdenum or tungsten in place of chromium, and columbium in place of tantalum. The alloy is said to be strong and can be used for acid-proof ware or for cutting tools.

Engineering and Mining Journal. Tantalum—a rival for platinum. Important facts about the metal. Vol. 123, May 28, 1927, p. 888.

A general article giving in detail the action of chemicals on tantalum.

Gregory, Arnold William. An improved process for the treatment of ores for the recovery of titanium, tungsten, and tantalum. British Patent 251527, May 6, 1926.

Hevesy, G. v. and Bohm, J. (Determination of tantalum by means of X-ray spectra.) Ztschr. anorg. allgem. Chem., vol. 164, 1927, pp. 69–80.

Jordan, Louis, and others. Tarnish-resisting silver alloys. U. S. Bureau of Standards Technol. Paper 348, 1927, pp. 348–496.

Found tantalum to have no value as an alloy of silver to prevent tarnish.

Marden, John Wesley, assignor to Westinghouse Lamp Co. Production of rare metals and alloys thereof. U. S. Patent 1648954, November 15, 1927.

Reduces tantalum and other refractory metals of high melting point by fusing a salt with a mixture of alkali chlorides, adding an excess of aluminum so as to form an aluminum alloy with tantalum or other rare metal treated, then distilling off the aluminum in an inert environment.

McCurdy, F. T., Alloy and process of making. U. S. Patent 1449338, March 20, 1923.

As an example, to an alloy 50 per cent cobalt, 25 per cent chromium, 15 per cent tungsten, 0.64 per cent silicon, and 2.22 per cent carbon, add 1.08 per cent tantalum. "The metal (after adding tantalum) is denser and finer grained in its microstructure, while the strength and permissible cutting speed are frequently increased by a third of their value in an exactly similar alloy without tantalum addition." Tantalum is added as columbite or Ta_2O_5, and 10 per cent Ta_2O_5 added to the charge has given good results. As much as 5 per cent tantalum as metal may be added;

Schoeller, W. R., Jahn, C., Powell, Alan R., and Deering, S. C. Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates. The Analyst, Cambridge, England.

A series of treatises on the chemistry of tantalum and columbium, of which the following have appeared:

Schoeller, W. R., and Powell, A. R. I. Use of tartaric acid in the analysis of natural tantalocolumbates. II. Separation of zirconium from tantalum and from columbium. Vol. 47, 1922, p. 93.

Digest only. Original articles appeared in Chemical Societies Journal, vol. 120, pp. 1927–1935, 1921.

SCHOELLER, W. R., and WATERHOUSE, E. F. III. The volumetric estimation of columbium. Vol. 49, 1924, pp. 215–220.

POWELL, ALAN R., and SCHOELLER, W. R. IV. A new method for the separation of tantalum from niobium. V. The detection and determination of tantalum in niobium compounds. Vol. 50, 1925, pp. 485–496.

In IV a method of separating columbium and tantalum by tannic acid is advocated. V detects tantalum in columbium. The tantalum is precipitated from solution by tannin.

SCHOELLER, W. R., and JAHN, C. VI. The precipitation of the earth acids by sodium compounds. Vol. 51, pp. 613–620, 1926.

——— VII. The precipitation of tungsten acid by tannin. VIII. The separation of tungsten from tantalum and columbium. Vol. 52, pp. 504–514, 1927.

SCHOELLER, W. R., and DEERING, E. C. IX. Separation of titanium from tantalum and niobium. Vol. 52, pp. 625–637, 1927.

TITANIUM

DOMESTIC PRODUCTION

Although still a very small item in the mineral industry of the United States, more rutile was shipped during 1927 than in any previous year. Unfortunately, owing to the objections of one of the two producing companies, the figures for production can not be published. Shipments of rutile were made both from Jacksonville Beach (formerly Pablo Beach), Fla., where it is saved by a subsidiary of the National Lead Co. as a by-product in the mining of ilmenite, and from Roseland, Nelson County, Va., where it is separated by the American Rutile Co. (a subsidiary of the Metal & Thermit Corporation) from syenite containing 3 to 6 per cent of rutile and an equal quantity of ilmenite.

Ilmenite was mined and shipped by these two companies and by the Burdick Mineral Corporation, which mined ilmenite from the south end of the beach at Redondo, Calif. The total quantity of ilmenite shipped was about 7,640 tons, ranging from 15 to 52 per cent TiO_2, equivalent to about 3,500 tons carrying 50 per cent TiO_2. The lower grade material was stock piled.

The production of titanium minerals in the United States during the last 10 years, so far as the data are available to the Bureau of Mines for publication, is given in the table following. The quantities shown are largely for shipments rather than direct production.

Titanium minerals produced in the United States, 1918–1927

Year	Rutile concentrates			Ilmenite concentrates		
	Short tons	Percentage of TiO_2	Value	Short tons	Percentage of TiO_2	Value
1918	261	95	$39,150	1,644	53–55	$18,000
1919[1]	102	94–96	20,400	106	48–50	2,120
1920	277	94–96	(2)	268	50	(2)
1921	----------	----------	----------	----------	----------	----------
1922	310	95	(2)	5,181	52–54	(2)
1923	270	95	(2)	6,270	52	(2)
1924	----------	----------	----------	4,769	52	[3]76,300
1925	46	95	[3]11,000	5,566	52	[3]89,000
1926[4]	30	95	[3]7,500	4,813	52	[3]77,000
1927	(2)	(2)	(2)	3,500	50	44,000

[1] Virginia production only; information regarding Florida not available for publication.

[2] Bureau of Mines not at liberty to publish figures.

[3] Arbitrary value.

[4] Figures for Florida only. Bureau of Mines not at liberty to publish figures for Virginia.

GENERAL CONDITIONS

No imports of titanium minerals during 1927 are shown by the published figures of the Bureau of Foreign and Domestic Commerce, but it is known that some thousands of tons were received from Brazil, Travancore (India), and Senegal.

Besides the work done on the titanium-bearing beach sands at Redondo, Calif., considerable attention was given to deposits of ilmenite-magnetite in the San Gabriel Mountains north of Los Angeles. The principal deposits are located in T. 4 N., R. 14 W., on the ridge south of Soledad Canyon, extending 5 miles easterly from Russ Siding on the Southern Pacific Railroad, and also in T. 3 N. and T. 4 N., Rs. 12 and 13 W., in an area southwest of Mount Gleason and north of Tujunga Canyon, in the vicinity of Mill Creek and its tributaries.[31] The ores are in coarse anorthosite.

These deposits possibly are the source of the ilmenite in the beach sands at Redondo, the mineral having been carried by tributaries down to the Los Angeles River, and by it along an ancient course to the Pacific at Redondo instead of to San Pedro where the river now empties into the Pacific. Besides the Burdick Mineral Corporation, H. D. Rankin and associates at El Segundo and the Titanium Corporation (Ford Von Bichowsky) at Burbank, Calif., have been experimenting with the ores.

An analysis of a specimen from Mount Gleason, made by S. Kazoff in the laboratory of Prof. W. M. Thornton at Johns Hopkins University, was as follows:

	A	B
	Per cent	*Per cent*
Silicon dioxide (SiO_2)	0.42	0.42
Water (H_2O) at 110° C	.07	.06
Titanic oxide (TiO_2)	23.13	23.09
Total iron (Fe)	48.90	48.81

The use of titanium in the manufacture of pigments is attracting more and more attention. During the year the Titanium Pigment Co. continued its operations at Niagara Falls, N. Y., and at East St. Louis, Ill., manufacturing both titanox (a pigment containing 25 per cent titanium dioxide, TiO_2, and 75 per cent barium sulphate, $BaSO_4$) and pure titanium dioxide. These pigments were said to have been found in 75 per cent of the brush enamels on the New York market. Titanox has also been used in baked enamel, lacquer, printing ink, wall paper, rubber, oil cloth, linoleum, window shades, etc.

During the year the Commercial Pigments Corporation erected a plant on Curtis Bay, Baltimore, for the manufacture of titanium pigments for which the Blumenfeld patents were to be used as a basis and obtained control of beach deposits of ilmenite in Travancore, India, from which shipments were made.

So far as known, no colored titanium pigments have been manufactured in this country or abroad, although various types have been described and patented for many years. The reason seems to be that the white pigments are superior, at least in covering power, to other pigments on the market, and tints are easily and cheaply added to the paints, so that there is not much call for the self-colored pigments.

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[31] Tucker, W. Burling, Mining in California: California State Min. Bur., vol. 23, chap. 3, July, 1927, pp. 296–297.

During the year announcement was made that the National Lead Co. had acquired for 12,000,000 crowns the control of Titan A. S. of Fredrikstad, Norway,[32] the first company to successfully manufacture a titanium pigment. The Titan Co. had two deposits of ilmenite-magnetite in Sogndal, south of Egersund and near Raegefjord and Jossing Fjord. One, the Laxedals deposit, was estimated several years ago to contain a quarter of a million metric tons of ore carrying 35 per cent TiO_2. The other, the Blaafjeldet deposit, was estimated to contain above the 100-meter level 30,000,000 metric tons of ore carrying 40 to 45 per cent TiO_2.

The Laxedals ore contains 20 per cent magnetite. The ore is sorted, crushed, classified, and tabled before being shipped to the factory at Frederikstad.[33]

The Titan Co. had established relations with the Société Industrielle du Titan in Paris, France, which was also acquired by the National Lead Co.[34] Only pigment grinding was done at this branch. An arrangement was made by the American company with the Interessen Gesellschaft Farbenindustrie A.-G. by which a plant was to be erected at Leberkussen, Germany. The Deutsche Gasglühlicht Auer Gesellschaft has a plant in Berlin for the manufacture of titanium white, in which ores from Norway and Sweden are used. The pigment made is said to lack the purity and whiteness of the Norwegian and American products.

In Italy the Società Anonima Titanium of Milan, a subsidiary of the Montecatini Co., erected a titanium white plant at Bovisa, which on June 1 began production at a daily rate of 5 tons of titanium oxide carrying 98 to 99 per cent TiO_2. The output is only about half of the plant's capacity.[35] The plant is understood to be working on processes covered by the Blumenfeld patents.

In Canada McArthur Irwin (Ltd.), 20 St. Paul Street, West Montreal, erected[36] a plant for the manufacture of titanium white pigment by a novel process,[37] in which titaniferous iron minerals are heated with carbon, and the iron content is reduced to metal in exceedingly small particles and is then dissolved in ferric chloride, forming ferrous chloride and leaving a residue of 77 to 80 per cent TiO_2 and 7 to 10 per cent iron and the gangue. The titaniferous residue is leached with sulphuric acid to produce a pure, very finely divided white titanium oxide. The ferrous chloride is electrolyzed to produce pure iron. The process is based on a price of $40 per ton for the electrolytic iron, and if the iron is sold at this price it is believed that the titanium oxide can be sold for less than white lead.

The ilmenite is to be obtained from Ivry, Quebec, 67 miles northwest of Montreal. The deposit is at a higher altitude than and 2 miles from Degrosbois on the Canadian Pacific Railway. The ore carries from 33.82 per cent TiO_2 and 47.86 per cent iron (Fe) to 34.62 per cent TiO_2 and 42.98 per cent iron (Fe).

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[32] Swensen, Laurits S., American consul, Oslo.

[33] Jebsen, G. A., Norwegian Titanium White Industry: Teknisk Ukeblad, vol. 67, pp. 231-240, Kristiania (Oslo), 1920 (in Norwegian).

[34] Industrial and Engineering Chemistry, News edition: Vol. 6, Jan. 10, 1928, p. 7.

[35] Osborne, A. A., acting commercial attaché, Rome.

[36] Lakin, Harry M., American consul, Montreal report, May, 1927.

[37] Leverin, H. A., Possible Production of Titanium White from Canadian Sources: Canadian Chem. and Metal., vol. 9, pp. 198-199, Toronto, 1925.

The ilmenite at St. Urbain is richer in titanium, carrying as much as 53.35 per cent TiO_2, but the haul to water transportation is 8 miles to a point 60 miles from Quebec. So far as is known, the plant did not reach actual production.

Besides its use as a pigment, many proposals have been made to use titanium in other ways, particularly in alloys, and a number of patents have been granted for such combinations, but one receives the impression that in most cases the exact influence of the titanium in the proposed alloys has not been determined. The wide interest in titanium is shown by the bibliography appended.

WORLD PRODUCTION

The world production of titanium minerals, as gathered from Government reports and other available sources, is shown in the following table:

World production of titanium minerals, 1926 and 1927, in metric tons

Mineral and country	1926			1927		
	Ore produced	Content of TiO_2	Value[1]	Ore produced	Content of TiO_2	Value[1]
	Metric tons	*Per cent*		*Metric tons*	*Per cent*	
Ilmenite:						
Brazil[2]	1,498	[3]53	$34,391	1,307	[3]53	$25,737
Canada (Quebec)	181	[3]35	600	1,841	[3]35	8,977
India (Travancore)	4,304	[3]54	36,859	(4)	(4)	(4)
Norway	4,200	41.5	33,725	(4)	(4)	(4)
Portugal	1,030	(4)	5,279	703	(4)	3,181
Senegal	5,748	[3]50	18,632	5,200	[3]50	16,323
United States	[5]4,366	[5]52	[5]77,000	3,175	50	44,000
Rutile:						
Norway	50	90-93	13,401	(4)	(4)	(4)
United States	[5]27	[5]95	[5]7,500	(6)	(6)	(6)

[1] Values as officially reported, converted to United States currency at the annual average rate of exchange as published by the Federal Reserve Board.

[2] Exports.

[3] Estimated.

[4] Data not available.

[5] Figures for Florida only. Both ilmenite and rutile were produced in Virginia, but the Bureau of Mines is not at liberty to publish the figures.

[6] Bureau of Mines not at liberty to publish figures.

BIBLIOGRAPHY

The following articles treating of titanium are among those which appeared or became available during 1927:

American Metal Market. Titanium resources, development, uses, and outlook. Mag. Sec., vol. 34, September 20, 1927, pp. 3–5.

The Sanford Hill deposit, Essex County, N. Y., owned by the McIntyre Iron Co., carries 62.8 per cent magnetite and 30 per cent ilmenite. Sixty-one miles of railroad would be necessary for transportation, owing to the ruggedness of the Adirondacks, although the deposit is only about 30 miles in a direct line from Lake Champlain. The deposit contains 100,000,000 tons of determined ore. By magnetic separation 1 ton gives $\frac{2}{3}$ ton carrying 7 per cent titanium (*sic*) + low phosphorus and sulphur. These concentrates have been used as $\frac{5}{16}$ of a blast-furnace charge with good results. The tailings are said to give $\frac{1}{5}$ ton ilmenite, 49 per cent TiO_2 and 34 per cent iron. An output of 1,000,000 tons per year would give 660,000 tons of magnetite and 200,000 tons of ilmenite. The deposit could be operated in terraces at low cost. The iron ore, carrying 56 per cent iron, and the ilmenite could be laid down at Lake Champlain for less than 4 cents per

unit and less than $4 per ton, respectively. Titaniferous hematites are found in greatest quantity probably in Norway, but notable deposits are found at Baie St. Paul and Ivry, Quebec. They carry 35 to 40 per cent TiO_2 and 50 to 55 per cent Fe_2O_3, but can not be separated magnetically. Possible beneficiation is by reducing the iron by carbon at a high temperature, then magnetic separation (Fitzgerald process) or by reduction at a low temperature, just high enough to sinter the ores. The iron and titanium minerals are then separated magnetically from the excess carbon. The concentrate is treated with weak H_2SO_4, to dissolve iron, leaving TiO_2 (Ladoff process). Beach deposits are not as large as those noted. Because it increases fluidity of slags it has been proposed to use ilmenite in place of fluorspar in basic open-hearth practice. The McIntyre Iron Co. could deliver its ore at $6 per ton, and fluorspar costs $20.

Barton, L. E., and Ryan, L. W. Titanium pigment. Canadian Patent 274070, September 20, 1927.

A concentrated aqueous suspension of calcium sulphate is added to a titanium solution and the charge boiled to precipitation of the titanium. The solution is filtered to separate the precipitates which are calcined.

Baughman, Will. The utilization and metallurgy of titanium. Mining in California (Rept. 13 of the State mineralogist), vol. 23, July, 1927, pp. 299–313.

Deposits of ilmenite are apt to have their titanium-ilmenite content overestimated because of the presence of other dark minerals. Lists ferrotitanium and other titanium alloys used in metallurgy. Refers to United States Patent 1570802, concerning the use of titanium nitride and cyano-nitride. States that Bichowsky and Harthan have a process for making titanium cyano-nitride to give a brilliant green pigment. Titanium tannate is said to be used in a water color pigment ranging from brick red to pure yellow. Light yellow pigments can be made by decomposing ilmenite with sulphuric acid and roasting at a temperature high enough to decompose the sulphates. Claims that calcined rutile finely ground and sintered can be formed into chemically resistant articles capable of conducting both heat and electricity. Claims that Bichowsky and Harthan have discovered that nitrogen may be fixed either as titanium nitride or titanium cyano-nitride; can be accomplished at much lower temperature in the presence of finely divided iron. These are too expensive to use as fertilizers but will be used as starting points for cyanide, ammonia, titanium oxide, and titanium ferrocyanide (green paint pigment). Describes Whittemore, Eustis, and Perrin processes for obtaining titanium oxide and claims that these patents can be used on titanium-iron ores of any titanium content. Claims that the fifth largest American titanium deposit is located at the head of Tujunga Canyon in the San Gabriel Mountains, Los Angeles County, Calif. The largest single deposit contains about 225,000 tons of 15 to 27 per cent ore, and there are several very large low-grade disseminated deposits. The region probably contains 2,000,000 tons of workable titaniferous iron ore. With reasonable grinding it can be separated into a high grade ilmenite and a low titanium magnetite.

Beloglazov, K. F. (Production of titanium tetrachloride.) Contrib. Study Nat. Resources, U. S. S. R. (Russia), 1926, No. 56, pp. 20–23. Chem. and Ind., Brit. Chem. Abs., vol. 46, September 2, 1927, p. 652.

Briquets prepared from titanium ore (ilmenite) ground to 0.5 millimeter, carbon, and starch paste are first heated in the absence of oxygen and then chlorinated, the residue being used in the next charge.

Blumenfeld, J. Titanium pigments. U. S. Patent 1639423, August 16, 1927.

Barium oxide or other metallic oxygen compound capable of liberating hydrogen peroxide by reaction with the acid in paint vehicles such as linseed oil is used with pigments such as titanium oxide.

Botts, E. D., and Krauskopf, F. C. Some electrochemical studies of titanium. Jour. phys. Chem., vol. 31, 1927, pp. 1404–1419.

A study of the electrode potential of titanium in solutions of titanous salts with and without the addition of acids and neutral salts. Methods of preparing pure titanium were investigated, and the purest titanium was obtained by reduction of pure titanium tetrachloride with sodium in a steel bomb. The electrode potentials of titanium in 4 solutions of titanium trichloride and titanous sulphate were 0.23 and 0.18 v., respectively (H standard).

Brown, L. S. Occurrence of rutile, ilmenite, and leucoxene in Mid-Continental sediments. Paper presented before the Eighth Annual Meeting of the Mineralogical Society of America, December, 1927.

Making some rather extensive investigations of so-called "heavy mineral" residues of Mid-Continent sediments (Permian red sandstones) it was found that approximately 70 per cent of such residues from a bromoform separation consisted of leucoxene, ilmenite, and rutile, the former predominating. Some of the characters observed include characteristic rutile and ilmenite structures and their survival in the leucoxene. Also alteration of rutile to leucoxene is demonstrated and attempts made to determine whether such alteration occurred prior or subsequent to disintegration of parent rock.

Chemistry and Industry. Manufacture of titanium compounds. Titan Co. A./S. British Patent 271085, May 11, 1927.

The hot solution of titanium and ferrous sulphates obtained by treating ilmenite with sulphuric acid is added slowly with continuous stirring to a quantity of hot mother liquor from which most of the titanium has been removed by hydrolysis under such conditions that the composition of the solution remains constant while the titanium salt is gradually hydrolyzed. As hydrolysis proceeds the liquor containing the suspended precipitate is withdrawn from the precipitation vessel, the precipitate is removed, and the hot mother liquor returned to the precipitation vessel, or treated separately at increased temperature and pressure in order to precipitate its remaining titanium content.

Chubb, L. J. The geology of the Austral or Tubuai Islands. Geol. Soc. Quart. Jour., vol. 83, No. 330, pp. 291–316, 1 Pl. London, 1927.

Ilmenite is found on Rapa Island but the deposits are of geologic interest only.

Clement, A. W. Titanium alloy. U. S. Patent 1621523, March 22, 1927.

An alloy that is resistant to corrosion at high temperatures comprises titanium 5 to 12 per cent, chromium 10 to 30 per cent, and silicon not over 1 per cent but in excess of the quantity normally present as impurity, the balance being aluminum and iron with carbon sufficiently low to avoid difficulty in working.

D'Ans, Jean, and Sommer, Fritz. Process of preparing titanic oxide from titanic ores. U. S. Patent 1655940, January 10, 1928.

One part of iron-bearing titanium ore is treated with two parts hot concentrated sulphuric acid, then leached with one part of water to one part of ore treated. Ferric sulphate in the solution is reduced to ferrous sulphate and is crystallized from the solution. The mother liquor is heated in an autoclave above 150° C. to precipitate titanium oxide. Concentrated sulphuric acid is added to the residual solution, which is then used to treat other ore. The ferric sulphate is reduced "in accordance with the usual methods"—as by electrolytic reduction or by metallic iron.

Dulac, A. (The manufacture of titanium white.) Rev. chim. ind., vol. 36, 1927, pp. 263–266, 294–297. Chem. Abs., vol. 22, January 20, 1928.

A description of the commercial manufacture of titanium white, based mainly on French patents.

Emmett, W. G. The use of titanous chloride in the volumetric estimation of copper and iron. Jour. Chem. Soc., 1927, pp. 2059–2062.

Flintermann, R. F. Ferrous alloy resistant to oxidation. U. S. Patent 1641752, September 6, 1927.

An alloy suitable for making carbonizing boxes comprises iron with aluminum 19.5 and titanium 1 to 5 per cent.

Gregory, Arnold William. An improved process for the treatment of ores for the recovery of titanium, tungsten, and tantalum. British Patent 251527, May 6, 1926.

Mixes ore, such as ilmenite, with such a percentage of carbon as will reduce the iron present from oxide to metal and also with a quantity of a fusible alkali salt such as sodium carbonate. The mixture is heated to bright red in a closed vessel to prevent access of air or in a reducing or neutral atmosphere. The resulting mass, which is pulverulent or lightly fritted together, is then treated with 2 per cent sulphuric acid, which removes practically all of the iron as ferrous sulphate. The residue contains nearly all of the titanium, tungsten, or tantalum. In treating an ilmenite carrying 40 per cent titanium oxide and 50 per cent iron oxide the mixture was ilmenite 100 parts, powdered coal 20 parts, and soda ash 20 parts. After fusion to bright redness in a closed chamber for an hour it was then treated with enough 2 per cent sulphuric acid to neutralize the soda and form ferrous sulphate in the iron. A slight excess was added to render the liquid faintly acid. The mass was then raised to the boiling point for an hour, and practically all the iron was in solution and the titanium in the residue. A temperature not exceeding 700 to 800° C. is used. The titanium oxide is in a form easily attacked by strong sulphuric acid.

Hagar, I. D. Titanium pigments. Paint, Oil, and Chem. Rev., vol. 84, No. 1, 1927, pp. 12–13, 27.

A review of the applications of titanox, titanium-calcium pigment, and pure titanium oxide.

Iron Age. Making sponge iron in Japan. Vol. 120, Oct. 6, 1927, pp. 937–938.

"Kuji is a small town on the eastern coast of Japan, about 100 miles from the northern tip of the main island. In some earlier geologic period the coast line rose, and now there is a strip of high table-land, more than 100 miles long and about 20 miles broad, extending along the shore, with Kuji in the center. Government surveys have found that deposits of ferrous beach sand extend for about 70 miles, averaging about 18 feet in thickness. One estimate, made by Government engineers in 1921, placed the total of such sand in one area of 22 square kilometers at 150,000,000 tons. The most conservative estimates give the entire area a minimum of 200,000,000 tons of ore. Others state that the field could fill Japan's present requirements of 2,000,000 tons of iron a year for several centuries. In the feudal era of Japan, when the Samurai carried their two swords, the metal for those famous blades came from an outcropping in the Kuji field. By the hand methods of the time the sand was worked into iron and steel of extremely high quality. The present Kuji plant is using sand from the original tunnels of this old sword industry. The finely divided metallic iron, together with the waste material in the original beach sands and the excess coal, is discharged continuously into revolving cylinders, rotating in water to cool the material to atmospheric temperature, to prevent the finely divided iron quickly burning back to iron oxide, which would occur if the temperature of discharge were too high. This cooled material is then passed over magnetic separators, where the metallic iron (and a certain proportion of ilmenite, which is magnetic) is separated from the waste material. The ilmenite which is carried over reduces the grade of the iron somewhat. There is no particular disadvantage to this other than that the ilmenite must be charged into the melting furnaces later on."

Jordan, Louis, and others. Tarnish-resisting silver alloys. U. S. Bureau of Standards Technol. Paper 348, 1927, pp. 348–496.

Find that titanium is of no use in forming a silver alloy resistant to tarnish.

Kennedy, R. R., and Oswald, G. J. Phosphorus and titanium retard growth of cast iron. Foundry, vol. 55, 1927, pp. 387–390. Chem. Abs., vol. 21, 1927, p. 2644.

The conclusions of other investigators as to the cause of growth of gray cast iron are briefly reviewed. A series of test bars including bars deoxidized by titanium showed that high phosphorus was effective and titanium especially so in retarding growth. Numerous photomicrographs are shown.

Klein, C. A., and Brown, R. S. Treatment of ores, etc., containing titanium and iron. British Patent 279219, September 17, 1926.

The slag obtained by smelting titaniferous iron ores according to British Patent 243081, 1926, is freed from suspended iron particles by granulation, crushing, and magnetic separation, or by treating the stream of molten slag with a jet of high-pressure steam and subjecting the disintegrated slag directly to magnetic separation.

Kouznetzov, I. G. (Loparite, a new mineral of the rare elements.) Com. geol. Russie Bull., vol. 44, pp. 663–682, 1925. Chem. Abs., vol. 21, p. 3862, 1927.

Loparite, from the nephelite-syenite near Imandra, is described as isometric, $n=2.3–2.4$, infusible before the blowpipe, insoluble in acids except H_2F_2. Formula: $11\ Ce\ (TiO_3)_2.6(Di,La,Y)_2(TiO_3)_3.6CaTiO_3.9(Na,K)_2TiO_3$. Loparite is a member of the perovskite group, with knopite lying between it and perovskite.

Labuntzov, A. N. (Ilmenite from the Khibin Tundra.) Russian Acad. Sci. Trudy Mineral Muzeia, Leningrad, vol. 1, 1926, pp. 35–42. (In Russian.)

Laporte, B. (Ltd.), Alcock, H. E., and Weber, I. E. White (titanium) pigment. British Patent 280435, April 4, 1927.

Three parts of titanium hydroxide are mixed with seven parts of blanc fixe, both being in the form of pastes in water, carbon or some carbonaceous material, that is, starch, sugar, oil, etc., is added, and the mixed mass is heated at

700 to 950° until the carbon has completely burned off. After cooling the residue is ground for use as a white pigment.

Lehmann, K. B., and Herget, L. (Hygienic properties of titanium dioxide and "titanum white.") Chem. Zeit., vol. 51, 1927, pp. 793–794. Abs. Chem. and Ind., vol. 47, No. 5, February 3, 1928, p. 100.

Titanium dioxide proved harmless when administered to cats, rabbits, etc., over periods up to 16 months, and titanium white is considered to be a perfectly nonpoisonous pigment. Methods for the analytical determination of titanium are described.

Lipine, V. N. (Importance of titanium in the manufacture of steel.) Messager ind. métaux russe Nos. 3–4 (March–April, 1926), pp. 5–17; Rev. métal. vol. 24 (Extraits), 1927, pp. 136–137.

After reviewing work published on the effects of titanium on the properties of steel, particularly of rail steel, Lipine describes unpublished tests made in 1898, and 1899. Titanium steels were prepared in refractory clay crucibles covered with a heavy coating of magnesium oxide. A batch containing more silicon (1.32 per cent) than titanium (0.42 per cent), although not very characteristic, showed that high tensile strength and elastic limit could be obtained, while a fairly high elongation was retained. With a ·1 per cent titanium steel better mechanical properties were obtained by quenching in H_2O, with or without tempering, than with an ordinary titanium-free carbon steel. Titanium increases the hardness and imparts exceedingly high elastic limit and tensile strength while a small elongation is retained.

Lubowsky, S. J. Soluble product from titanium dioxide or rutile. U. S. Patent 1640952, August 30, 1927.

Titanium oxide or rutile is calcined with magnesium oxide at a temperature approximating Seger cone 18 to obtain a product which is soluble in inorganic acids and suitable for making other titanium compounds.

Lunde, Gulbrand. (Titanium sesquioxide.) Ztschr. anorg. allgem. Chem. vol. 164, 1927, pp. 341–344. Chem. Abs., vol. 21, November 20, 1927, pp 3845–3846.

Titanium dioxide heated in a stream of hydrogen for 20 minutes at 1,000° lost 4.64 per cent in weight, whereas the transition from titanium dioxide to Ti_2O_3 requires 10 per cent. According to the method of Friedel and Guerin, a mixture of hydrogen and $TiCl_4$ is passed over titanium oxide at about 650°. An amorphous blue-black product and, in very small quantities, a red-violet sublimate were obtained. The temperature was then raised to 1,000° and the product heated in the $TiCl_4$ stream for 30 minutes. X-ray investigation indicates that the product obtained is identical with that of Friedel and Guerin.

MacKay, P. A. Processing titaniferous ore. Canadian Patent 269983, April 19, 1927.

Oleum is gradually added, with stirring, to a damp powdered mass of ilmenite.

———. Titanium oxide. United States Patent 1613234, January 4, 1927 Canadian Patent 269983, April 19, 1927.

Damp powdered titaniferous ore is treated with oleum and the resulting mixture of sulphates of iron and titanium is diluted to precipitate hydrated titanium oxide.

Mawdsley, J. B. St. Urbain area, Charlevoix District, Quebec. Canadian Dept. Mines Geol. Surv. Mem. 152, Ottawa, 1927, pp. 44–53.

Describes the ilmenite-hematite deposits. They contain some rutile.

Monk, R. H., and Irwin, J. Titanium pigments. British Patent 266211, August 6, 1926.

A titanium ore is treated with an alkali metal sulphate and an acid; for example, with sodium bisulphate and sulphuric acid at a temperature (suitably 120 to 260°) below the fusing point until a solid cake is obtained, and this is cooled, crushed, and extracted with H_2O. Iron may be preliminarily removed by reduction to spongy iron with carbon at 900 to 1,050° and leaching with ferric chloride. The titanium is precipitated from the sulphate solution by hydrolysis at a temperature of 75 to 95°.

Moulinet, M. Les gisements d'ilménite dans la baie de Cam Ranh. L'Echo des Mines, vol. 55, p. 109, Paris, 1927.

Numerous deposits of ilmenite sand are known on the coast of Annam, the most interesting of which is on the Baie de Cam Ranh, 45 kilometers south of Nhr-Trang. Sand dunes contain 1 gram to 8 kilos of ilmenite per ton. On the coast are irregular comparatively rich concentrations. The author estimates from incomplete prospecting 125,000 tons of ilmenite in the dunes and 35,000 in the beach.

Pehrman, G. Om en titanjärnmalm och omgivande bergarter pa Attu Landet i sydvästra Finland. (About a titaniferous iron ore and the surrounding rocks on the Island of Attu in southwestern Finland.) Geol.-Mineral, Inst. Abo Akad., Meddel. No. 6, 83 pp., 4 pl., 7 text figs., Helsingfors, 1927.

Titaniferous magnetite is connected with a gabbro intrusion. One analysis gave 29.97 per cent TiO_2.

Rue, Edgar Aubert. Sur quelques minéraux de la Côte d'Ivoire. Compt. rend., vol. 184, Jan. 10, 1927, pp. 104-106. Also under the title, Contribution à l'étude minéralogique de la Côte d'Ivoire. Com. d'Etud. Hist. et Sci. l'Afrique Occ. Française Bull., vol. 10, 1927, p. 205.

Ilmenite forms important deposits along the Gulf of Guinea. The principal deposits observed are near Blieron, between Nero and Lake Petit Digboue, between San Pedro and Petit Pedro in Bas-Cavally; also between Victory and Monogaga in Bas-Sassandra. Cassiterite exists in small quantities in most of the titaniferous sands. The following analysis of a specimen of sand taken from the beach near Blieron gives an idea of the composition of the deposits:

	Per cent		Per cent
SnO_2	2. 2	Fe_2O_3	23. 5
SiO_2	2. 2	Mn_3O_4	1. 5
ZrO_2	7. 4	Fe_3O_4	26. 3
TiO_2	37. 1		

[By magnetic separation the TiO_2 content could, according to this analysis, be easily raised above 52 per cent. The residue should be valuable for its tin and zircon content. The analysis does not show enough SiO_2 to make zircon.]

Schwartz, H. A. Malleable iron castings. U. S. Patent 1636657, July 19, 1927.

In making malleable iron castings containing an inappreciable quantity of silicon a graphitization accelerator, such as titanium and aluminium 0.10 to 0.15 per cent, is added to the iron, and the metal is cast without precipitating any substantial proportion of the carbon and then annealed to precipitate the carbon in small particles.

Singer, F. Ceramic insulators. U. S. Patent 1642754, September 20, 1927.

Titanium compounds such as titanium oxide or calcium titanate are added to the ceramic mix, and it is burned with an oxidizing flame and with a reducing flame to form both crystallized and amorphous titanium compounds.

Specht, N. Titanic oxide. U. S. Patent 1649496, November 15, 1927.

A product of good covering properties is obtained by using solutions of titanium sulphate having a specific gravity of 1.35 to 1.55 and hydrolyzing at temperatures of 160 to 180°.

———. Titanium paint. Canadian Patent 270694, May 17, 1927.

A paint containing titanium is manufactured by partly neutralizing the sludgy residues of treated titaniferous ores by means of alkalies and then neutralizing the slight remainder of acid by means of ZnO.

Spence, H. *See* Spence, P., & Sons, Kirkham, A., and.

Spence, P., & Sons, Kirkham, A., and Spence, H. Titanium sulphate. British Patent 263886, July 1, 1925.

Hydrous titanium sulphate ($TiO.SO_4H_2O$) in fine granular form is obtained by heating, preferably with agitation, a titanium sulphate solution containing 4 to 12 or more molecules of sulphur trioxide to each molecule of titanium oxide at a specific gravity (tested cold) of 1.5 to 1.75 and at a temperature of 90 to 135° or higher. Various details for regulating the process are described.

Stansfield, Alfred. Smelting titaniferous ores of iron. Iron and Steel of Canada, vol. 10, pp. 263-267, 271, 1927. Chem. Abs., vol. 21, p. 3865, 1927.

The principal Canadian deposits of titaniferous iron ores are briefly described. Magnetic concentration does not separate the iron from titanium. Much more fuel is required to smelt titaniferous ores than for hematites. By making cones containing TiO_2, SiO_2, and CaO in varying proportion, together with 10 per cent A_2O_3 in each mix, the limiting percentage of each variable to produce a low-melting slag (1,185 to 1,210°) was determined. In the presence of nitrogen, however, the cones when heated to 1,400° or above were coated with a difficultly fusible titanium nitride. The dark blue oxide of titanium is not Ti_3O_5 but probably Ti_4O_7. When titanium oxide is heated at 1,600° in a stream of CO and nitrogen, probably titanium carbide is formed. Above 1,600° the oxide is converted into a copper-colored substance, possibly Ti_3CN_4. On contact with carbon the molten slag effervesced and gradually became less fusible. Possibly nitride, as well as TiC, was formed. The TiO_2 content of mixed ores must be kept below 1.5 per cent for foundry iron and below 3 per cent for malleable iron. By the magnetic concentration of titaniferous magnetites the TiO_2 content can be brought down to 5 or 10 per cent. By mixing such a beneficiated ore with siliceous ores it may be possible to smelt it economically. Concentrates when sinter roasted will probably be easily reduced and can therefore be smelted in admixture with siliceous hematites for the production of a superior grade of pig iron.

Stephens, F. G. C., Anderson, L. J., and Cash, W. A. Titanium-containing pigments, production of. British Patent 273017, 1927.

To obtain titanium pigments of great covering power and whiteness, ground ilmenite is treated with concentrated sulphuric acid, filtered, diluted, alkaline earth sulphate added, and the mixture boiled to precipitate hydrated titanium oxide on the sulphate. The mixture is filtered, and the residue suspended in water and neutralized with barium or calcium carbonate. Calcium or barium borate in the proportion of 2 to 4 per cent of the titanium oxide is then intimately mixed with the suspension, which is then filtered, dried, and heated to 700 to 900° C. A larger proportion of the borate may be employed.

Suirokomskii, V. S. (Titanium ore deposits in U. S. S. R.) Contributions to the study of the natural resources of the U. S. S. R. No. 56 (Titanium and its compounds, No. 1), 1926, pp. 58–73. (In Russian.)

A review of the deposits of titanium ores in the various parts of Russia and the types of titanium minerals found. None are very rich in TiO_2 when compared with the various foreign beach deposits.

Thornton, W. M. Titanium, with special reference to the analysis of titaniferous substances. New York, 1927, 261 pp., 26 text figs.

This is the most extensive study of titanium yet published and the most authoritative. Although considered from the chemist's viewpoint, the industrial phases are excellently treated.

Titan Co. Treating titaniferous solutions. British Patent 279786, 1927.

The reduction by metallic iron of solutions containing titanium and iron—for instance, those obtained by treating ilmenite with sulphuric acid—is carried out with solutions. The titanium content is from 90 to 130 grams of titanium oxide per liter, and at temperatures below 60° C. the temperature being, if desired, allowed to rise above 60° C. toward the end of the reduction. The calculated amount of reducing agent may be used, particularly when a material of large surface such as sponge iron is employed, or excess of iron may be used if the process is interrupted when the desired degree of reduction has been effected.

Vignau, P. T. Las arenas ferruginosas de Necochea. Rev. de la Facultad de Cien. Quim., vol. 4, part 2, Buenos Aires, 1927, pp. 1–32, 6 pls.

Large quantities of black sands are said to exist in small dunes which were separated thus:

1. Magnetic titaniferous magnetite	per cent	29.22	(15.94 TiO_2)
2. Ilmenite, nonmagnetic	do	24.76	(22.55 TiO_2)
3. Mixed sand, ferruginous, nonmagnetic	per cent	27.89	(8.50 TiO_2)
4. Common sand	do	18.13	(2.05 TiO_2)

The deposit is said to extend a long distance along the coast south of Necochea. From Quequen to Punta Negra, 15 kilometers to the south, without interruption the black sands are from 30 to 80 meters wide. They have also been reported from the Patagonian coast, at Punta Ballena, near Piriapolis, Uruguay, on both sides of the Andean cordillera, and on the Pacific coast.

Whiteley, J. T. Rustless alloy steel Assignor to E. J. Spinka. United States Patent 1647491. November, 1927

The alloy contains 8.75 per cent chromium, 3 per cent nickel, 1 per cent copper, 1.5 per cent silicon, 0.2 per cent carbon, 0.75 per cent zirconium, 0.5 per cent titanium, and the remainder iron.

WORDEN, E. W. Chemical patents index. Chem. Cat. Co., Inc., N. Y., vol. 1, 1927, pp. 546–547.

Lists many patents on the extraction, manufacture, and use of titanium compounds.

Zeitschrift für praktikalische Geologie. Titaneisen. (Titaniferous iron ore.) Lagerstätten Chronik., vol. 36, No. 1, Halle a. S., 1928, p. 8.

An extensive deposit of titaniferous iron occurs in northeast Ceylon, about 55 kilometers north of Trincomalia. Reserves estimated at 2,000,000 tons. Material believed suitable for making titanium white.

TUNGSTEN

GENERAL CONDITIONS

In 1927, as it has since 1918, Chinese tungsten ore dominated the markets of the United States and of the world. Aside from this domination, which has come to be somewhat of a tale that is told, the most striking feature of the tungsten market was its dullness, possibly due to ample supplies bought and sold at figures that did not allow a great deal of competition through lowering of prices. The United States mined, roundly, about half as much tungsten as it imported. In other words, of the visible new supplies on the American market about one-third was of domestic production.

UNITED STATES

In 1927 the United States produced an equivalent of 1,164 tons of tungsten concentrates carrying 60 per cent of WO_3 and valued at $724,000, or $10.37 per unit, including some low-grade ores sold. This is to be compared with 1,382 tons produced in 1926. In the various mines and prospects 255 men were reported as employed, but this figure undoubtedly includes some men employed on work not directly connected with tungsten mining and milling. The tungsten production of the United States during the last 10 years has been as follows:

Concentrated tungsten ores (reduced to equivalent of 60 per cent WO_3) produced in the United States, sold in 1918–1927, and average price per unit

Year	Short tons	Value	Average price per unit
1918	5,061	$7,049,300	$23.24
1919	327	353,900	18.02
1920	216	101,800	7.86
1921–22	----------	----------	----------
1923	241	144,600	[1]10.00
1924	[2]565	[2]$287,000	$8.47
1925	1,191	755,500	10.57
1926	1,382	920,400	11.10
1927	1,164	724,000	10.37

[1] The output of 1923 was made by one company only, which sold to its owners at a price considerably above the market.

[2] Includes 191 tons produced in 1919, sold in 1924 for $87,000.

Domestic prices ranged from $10 to $11 for domestic scheelite and $10.25 to $10.75 for Chinese wolframite.

California.—The Atolia Mining Co. worked its veins through the Rush Leasing Co. but did the milling for the lessee. Under the management of A. V. Udell milling practice has been greatly simplified, and the sliming has been greatly reduced. Residual placers below the Papoose vein were worked for a time with a gas-electric shovel, but work ceased when, in the summer, prices fell to $10 per unit.

The Tungsten Products Co., 20 miles north of Bishop, Calif., did little more than development work.

Colorado.—In Boulder County the Wolf Tongue Mining Co., the oldest tungsten company in the district, had the misfortune to lose its mill by fire early in the summer. A new mill was built which was ready for work in December. Some excellent ore was discovered during the year. The company offered a free lease for six months to anyone discovering a new vein on the company's land. It is said that a number of new veins were thus found.

The Molybdenum Corporation of America, George Teal, the Clipper Tungsten Mining & Milling Co., and the Ferberite Tungsten Mining Co. each made a small production of ferberite.

The Tungsten Production Co. mined ferberite from various properties east of Nederland and, according to newspaper account, acquired properties in Arizona and Nevada.

South Dakota.—In South Dakota the Homestake Mining Co. continued mining wolframite from its Hidden Fortune claim on the hill directly west of the center of Lead and only a few hundred feet from the great "glory hole" of the Homestake gold mine.

The deposit is near the top of the smoothly rounded hill and is in a thin flat-lying bed of dolomite which lies between quartzite and shale above. Wolframite has replaced the dolomite very irregularly, as is usual in such deposits, but in general the ore bodies are lenticular and follow rather definite trends of about N. 32° W. The bodies have been as much as 70 feet wide. The tungsten-bearing bodies are bordered by a porous friable rock, largely hydrous iron oxide and small particles of silica (which the miners call sand), from which part of the original minerals, probably mostly pyrite, have been dissolved. Gold is found with the ore, and assays of selected specimens are said to have shown more than $480 per ton. The ore as mined has probably averaged $3 per ton, with some silver. Most of the wolframite is in small lenses a few inches long and broad and from a fraction of an inch to several inches thick. Lenses have been mined, however, that were a number of feet long and wide and 3 or 4 feet thick; these yielded wolframite carrying 68 to 70 per cent WO_3.

The gold does not seem to be confined to the same channel or to such definite channels as the wolframite. The tungsten does not necessarily accompany the gold, but the gold occurs with all of the wolframite, seeming to mean that the two elements were deposited at different times and that the tungsten probably came in with later solutions when not so many channels were open. To save the gold, the ore from the stamps is passed over amalgamated plates and the tailings are cyanided.

The ore contains small vugs in which may be one or more of the minerals calcite, quartz, scheelite, barite, jarosite, or rarely wulfenite.

On the west side of the hill a considerable quantity of float wolframite was dug out of the débris during 1917 and 1918, but none was found on the north end. The deposit is very similar to that (now worked out) exploited by the Wasp No. 2 Mining Co. on Yellow Creek, 2 miles south of Lead.

Analyses of carload lots of concentrates shipped in 1926 were as follows:

Analyses of carload lots of tungsten concentrates shipped by the Homestake Mining Co. in 1926, in per cent

	1	2	3	4	5	6	7
Moisture (H_2O)	--------	--------	0.88	--------	--------	--------	0.43
Tungsten trioxide (WO_3)	30.99	32.94	34.24	44.19	61.33	61.40	62.85
Phosphorus (P)	.14	.20	.21	.15	.025	.046	.05
Sulphur (S)	.68	.80	.75	.52	.29	.32	.37
Arsenic (As)	.65	.49	.57	.47	.28	.22	.24
Manganese (Mn)	2.65	2.9	3.1	3.3	3.8	3.65	4.00
Iron (Fe)	33.95	32.7	30.4	27.5	19.3	19.75	17.55

No calcium is shown in the analyses, but the concentrates undoubtedly contain a little scheelite. It was planned to rearrange the mill so that no more low-grade concentrates would be made.

Nevada.—The Nevada-Massachusetts Co. continued work on its property in the Eugene Mountains, 12 miles N. 65° W. of Mill City, Nev., where it mines scheelite from two contact metamorphosed limestones which have been altered by intruded granodiorite; this company was the principal producer of the year. The beds worked are 3 to 4 feet thick and lie between beds of hornfels. The main or Stank shaft was sunk below the 500-foot level, which when visited by the writer in August was showing excellent ore; part of it was said to carry 10 per cent WO_3. The average content of the ore, however, is said to be about 1 per cent WO_3. The ore was quartzose with some dark-green actinolite and contained only a little garnet; scheelite was plainly visible. The ore shoot was said to be about 260 feet long. The bed dips from 60° to vertical and has been stoped through most of the depth, but here and there are patches too lean to work. As is to be expected from the geological history of such a deposit faults are common, and finding the continuation of the beds is a difficult problem. Notable success in solving such problems was had on the fourth and fifth levels. A flow of water estimated at 105 to 110 gallons per minute was struck on the fifth level.

The adjoining property on the north, formerly owned by the Nevada-Humboldt Tungsten Mines Co. and now by the United States Smelting, Refining and Mining Exploration Co., was leased to the Nevada-Massachusetts Co.

The Tungsten Dyke Leasing Co. mined scheelite on the Wagner claims on the Silver Dyke vein, 13 miles by road southwest of Mina and probably about 9 miles in a direct line. The vein runs nearly east and west and dips about 72° N.

The "Silver Dyke" is a netted vein that in places contains great masses of nearly solid quartz and in other places is made up of anastomosing stringers. It cuts across the mountains for at least 3 or 4 miles through various rocks, and it is claimed that the vein can be followed several times as far. At the Wagner mine the vein is 6 to 20 feet wide. A couple of miles west quartz is thickly distributed through at least 250 feet.

Scheelite is found in shoots widely separated. The country is very rugged and so dry that the company had to suspend work for lack of water. Working expenses under these conditions are necessarily very high. The reserves, so far as can be seen, are comparatively small, and although the scheelite concentrates are apparently very pure mining can probably be profitably done only under high prices. There is a small mill on the property.

During the year George B. Wright discovered a narrow vein of ferberite on Indian Peak north of Rochester in the Humboldt Range.

The Tungsten Production Co. of Boulder, Colo., took over some of the contact metamorphic deposits on the east side of the Nightingale Range, east of Lake Winnemucca.

Arizona.—In Arizona a little wolframite from the Hillside district and a little huebnerite from Dragoon and from the Las Guigas district, near Arivaca, were mined.

Missouri.—A little wolframite was mined in Missouri by the Ozark Tungsten Co. and Edward C. O'Brien in sec. 23, T. 33, R. 5 E., 10 miles west of Fredericktown.

IMPORTS

The imports of tungsten in ore and various manufactured products during the past nine years are shown in the table following:

Tungsten ore, ferrotungsten and tungsten metal, tungsten alloys, and tungsten chemicals imported for consumption in the United States, 1919–1927 [1]

Year	Tungsten ore and concentrates [1]		Tungsten and ferrotungsten, tungsten chemicals, powder, and acid [1]		Ferrochromium-tungsten, chromium-tungsten, chromium-cobalt-tungsten (W content)		Tungsten-nickel and other alloys of tungsten (W content)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1919	18,816,000	$6,261,190	396,460	$287,981	------	------	------	------
1920	3,897,600	779,593	1,997,719	1,180,829	------	------	------	------
1921	3,227,840	276,757	507,206	180,371	------	------	------	------
1922:								
Jan. 1–Sept. 21	3,301,760	279,190	1,037,069	380,732	------	------	------	------
Sept. 22–Dec. 31	------	------	30,876	13,254	------	------	885	$741
1923	------	------	78,972	25,907	------	------	49	2,258
1924	------	------	132,987	46,156	8,800	$2,702	71	536
1925	854,059	206,326	839,194	316,454	396	352	------	------
1926	2,534,636	566,996	330,365	116,879	18,795	7,822	71	417
1927	2,170,657	540,409	27,272	9,777	66	377	56	328

[1] Prior to Sept. 22, 1922, imports recorded as ore, alloys, etc.; beginning with change in tariff, recorded as tungsten content of ore, alloys, etc.

FOREIGN PRODUCTION

China.—As has already been said, China continued to dominate the world's tungsten market. In 1927 the exports were reported as 83,270 pikuls, valued at 1,250,229 haikwan taels. Taking the haikwan tael as worth 45.03 cents, this is equivalent to about 6,245 short tons of concentrates carrying 60 per cent WO_3, valued at $562,978. The largest part of the output seems to come from southwestern Kiangsi and smaller quantities from adjacent parts of Kwangtung and Hunan. So far wolframite has been the only tungsten mineral shipped, and it is mined from both placers and veins. The resources of the area are unknown to foreigners and probably to the Chinese themselves.

The wolframite is accompanied by cassiterite (tin oxide), bismuth, arsenopyrite, and other minerals. It is hand picked in China and the bismuth is separated; but the cassiterite must be separated electromagnetically, and that is done in America or Europe. Part of the concentrates coming to the United States is cleaned in England.

Very few white men have seen even the larger part of the Chinese deposits, and no authoritative reports are known to have been issued. As nearly as can be ascertained China has produced and shipped since the first recorded exports in 1914 to the end of 1927 a total equivalent of 54,311 metric tons, or 59,868 short tons, carrying 60 per cent WO_3.[38]

Very much the larger part of these exports has come from placers, and placers are still being actively exploited.

How long these placers may last or how large the lode deposits may be is yet a matter of the merest conjecture. All that can be certainly said is that China continues to produce annually between 5,000 and 8,000 short tons of wolframite concentrates carrying 65 to 70 per cent WO_3 at from $2.32 to $2.92 per short ton unit (20 pounds of tungsten trioxide, WO_3), loaded at Pacific ports.

In addition to labor costs,[39] which increased during 1927 at a rate roughly approximate to the depreciation in the currency in which payment was made for the ore, taxes on cargo storage and movement, as well as transportation costs, advanced.

According to dealers, larger quantities of wolframite were sent to Europe, particularly Germany, England, and France, than to the United States. The German combine centering in Hamburg, according to local reports, received information that the financial position of Chinese dealers was not strong and refrained from purchases in the hope of reducing prices.

As there is no exchange or association in Shanghai providing a center for information, it is impossible to give an official estimate of tungsten stocks. Low prices, however, have caused dealers to reduce quantities on hand. Prices c. i. f. New York remained at $3.10 to $3.35 a unit during the third quarter, inclining toward the lower figure near the end of the period. The prices for delivery at European seaports were almost exactly the same as those asked for delivery in New York.

No further taxes or shipping exactions have been levied upon the trade since those put into effect in 1926 and 1927. There is, therefore, a tax of 3 Mexican dollars, or approximately $1.35, per pikul (133⅓ pounds) levied by the Chinese authorities at the point of original shipment, usually at Nanchang, capital of Kiangsi Province, and a further tax of 5 per cent by the Chinese Maritime Customs Service, usually at the port of Kiukiang, for exportation from China. No protective or other legislation, so fas as is known, is contemplated by the Chinese Government in charge of Kiangsi Province.

Burma.—As will be seen in the succeeding paragraphs, Burma, China's greatest competitor in tungsten production, apparently can not begin to increase production much until the open market price reaches about $5.35 per short ton unit. Burma is the producer next largest to China. Charles J. Pisar, American consul at Rangoon, gives the following data on the Burmese tungsten industry during 1927:[40]

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[38] As actually shipped the concentrates are richer than 60 per cent WO_3 and are considered as averaging 67.5 per cent WO_3. To show proper relationships ores must be reduced to some common standard, and in these reports 60 per cent WO_3 has been used as the standard for many years.

[39] Commerce Reports, Apr. 23, 1928, p. 221.

[40] Commerce Reports, Apr. 9, 1928, p. 108.

In 1927 Burmese mines which depend on the production of wolfram alone were closed down, since the market prices and limited demand made mining unprofitable. The mines in which tin and wolframite are associated, however, were active during the year. The wolframite ores were separated from the cassiterite [tin] ores and stocked, awaiting an improvement in the market.

The third quarter appeared to introduce a period of further depression, and the market was dormant as London prices fell from 15s. to 12s. 6d. [$3.65 to $3.04, equivalent to $3.26 and $2.71 per short-ton unit] per unit, and the industry remained stagnant in the fourth quarter despite increased exports of wolfram from Burma. Various estimates indicate that the stocks held in storage are not large.

In the past the Government of Burma has given financial assistance to the miners of wolfram when the market for wolfram and tin has been severely depressed. This aid at first took the form of a Government guaranty to a local bank to advance loans to the mines in difficulty. Funds were advanced to the companies against the security of mixed concentrates of tin and wolfram lodged with the Government agent, the Burma Finance & Mining Co., at the rate of 10 rupees per unit of wolfram and 25 rupees per unit of tin. As an additional security all the beneficiaries were made jointly and severally liable for the whole debt. On February 1, 1924, however, the Government assumed the entire debt, and at that time the beneficiaries executed another agreement, which provided for the mortgage of all their interests in immovable property in Burma as further security.

The Government advanced a total of $1,319,118, of which $472,659 was outstanding on February 1, 1924, when the Government took over the debt from the bank. On September 10, 1925, there remained $290,029 still outstanding, and at that time it was hoped to have the entire amount liquidated within a year. A fairly brisk export demand for wolfram toward the close of 1925 reduced the total stocks controlled by the Government to about 50 tons before the end of the year. This small lot was exported at the beginning of 1926, and the Government guaranteed pool has since been discontinued. The exportation of wolfram is now conducted privately by the various mining companies without any Government assistance.

With the low price that has ruled for wolfram during the past few years many small producers, whose operations were confined primarily to wolfram, have ceased mining or have gone out of business altogether. These miners find it impossible to operate at a profit when the cost of wolfram drops below 30s. [$7.30, equivalent to $6.52 per short-ton unit] a unit. The larger companies, whose primary output is tin, have given increased attention to production as tin prices have risen and at the same time, accordingly, increased their output of wolfram. The increase in the output of wolfram by the larger companies is partly offset by the decreased output of the small miners while low prices hold.

[Although it may be, as Pisar says, that operations for tungsten alone would not begin below 30s. per long-ton unit (22.4 pounds of WO_3), it is reported that some operations would begin at 24s. or 25s., say, $5.35 per short-ton unit.]

The London quotations of 15s. to 16s. a unit at the beginning of 1927 were too low to enable the mines which produce wolfram only to operate profitably. Practically all these mines remained shut down, and the only wolfram produced was that found in conjunction with the tin deposits. The tin mines, being able to obtain favorable returns for tin, attempted to increase their output and sold the wolfram at the current market prices without loss.

The following table shows the destination of the shipments of ore during 1926 and 1927.

Burmese shipments of wolfram ore, 1926–27, by ports and destinations, in long tons

Country of destination	Rangoon		Tavoy		Total	
	1926	1927	1926	1927	1926	1927
United Kingdom	1,006	1,040	134	150	1,140	1,190
Germany			430	426	430	426
Belgium			75	95	75	95
France			30	150	30	150
United States			55		55	
	1,006	1,040	724	821	1,730	1,861

The wolfram ore shipped to the United States in 1926 ranged in price from 18s. 3d. to 24s. a unit c. i. f. New York. The WO_3 content of this ore ranged from 66.69 per cent and Sn 2.34 per cent to 70 per cent and Sn 1½ per cent. There were no exports to the United States in 1927. The 1926 exports from Rangoon consisted of 142 tons of high-grade ore which originated in the Tavoy district and some from the Mawchi mine.

The Mawchi mine is located near Mawchi, in the southern portion of the Bawlake, State of Karenni. There are at least 10 important veins, all in granite, varying from 2½ to 5 feet in thickness. The vein stuff is drusy and carries cassiterite, wolfram, arsenical pyrites, pyrite, chalcopyrite, and black tourmaline. The concentrates as shipped are known as "crude scheelite wolfram tin concentrates." The WO_3 content, however, does not exceed 20 to 25 per cent.

This mine was closed down for nearly five years up to the beginning of 1926. It has no railway connection with Rangoon. The ore has to be hauled by bullock carts to the Salween River, whence it is floated down to Moulmein and then railed to Rangoon. In the dry season transportation difficulties are found in the low water of the Salween River, and in the rainy season the roads between the mine and the river are almost impassable. This makes the cost of transport exceedingly high.

In 1925 the mine was reorganized, and the English firm of Murex (Ltd.), tungsten manufacturers and iron founders, sent an engineer to Burma to examine the property, and, according to reports, acquired a financial interest in it. Since the reopening of this mine all the concentrates obtained have been shipped to the Murex plant for treatment.

The shipments from Rangoon (see preceding table) were probably from Mawchi, carrying only 20 to 25 per cent WO_3, and the totals do not check well with the production figures reported by the Geological Survey of India,[41] which gives the following table:

Tungsten ore produced in India, 1926 and 1927, in long tons

	1926			1927		
	Quantity	Value (£1=Rs. 13.4)		Quantity	Value (£1=Rs. 13.4)	
Burma:	*Tons*	*Rs.*		*Tons*	*Rs*	
Mergui	9	5,618	£419	8	4,070	£304
Southern Shan States	733	[1] 358,999	26,791	630	[1] 309,330	23,084
Tavoy	742	406,347	30,325	522	256,603	19,149
	1,484	770,964	57,535	1,160	570,003	42,537

[1] Estimated.

It seems probable that the ore carried about 65 per cent WO_3.

Malay States.—In the Federated Malay States, as in Burma, the production of tungsten concentrates was apparently almost wholly a by-product of tin mining. The exports were all from Perak and amounted to 336.55 pikuls,[42] or 22 short tons. From Penang 38.71 long tons of wolframite and scheelite was exported during the first half of the year. It presumably carried 65 per cent WO_3 and was equivalent to 47 short tons of 60 per cent WO_3. As in Burma, for profitable mining the sale price of concentrates seems to be about $5 to $6 per unit. From the Unfederated Malay States Kedah reported exports of 108 short tons of wolframite, valued at 40,400 Straits dollars, and Trengannu 65 tons, worth 18,592 Straits dollars, during the Mohammedan year ended July 1, 1927.

Other countries.—Little news is at hand concerning production in Portugal, Bolivia, and other countries. Tasmania and Queensland seem to be the only parts of Australia in which tungsten mining continues, and the output is small.

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[41] Fermor, L. L., The Mineral Production of India During 1927: Geol. Surv. India Rec., vol. 61, pt. 3, 1928, p. 242.

[42] Federated Malay States, Chamber of Mines, Year Book, 1927, Ipoh, 1928, p. 73.

PROBABLE EFFECT OF PRICE INCREASE

Should prices rise, the output of China would undoubtedly increase almost immediately. If the price should reach $5 per unit, the output from Burma (unless the price of tin should drop at the same time and so offer less inducement for Burma to increase its output), the Malay States, Bolivia, and probably Portugal would increase, and consumption would have to be greatly augmented to keep up with production.

WORLD PRODUCTION

The world production of tungsten, as shown by the ores shipped or marketed, from 1918 to 1927, so far as statistics are available, is given in the following table compiled by L. M. Jones, of the Bureau of Mines, from official reports:

World production (as shown by sales or exports) of tungsten ore, 1918–1927, by metallogenic provinces and political areas, in metric tons of concentrates containing 60 per cent of WO_3

Province and area	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
ASIA										
Japo-Korean province:										
Japan	629	574	170	------	------	------	------	------	19	(1)
Chosen (Korea)	1,100	197	5	(2)	14	(1)	(1)	(1)	(1)	[3]300
Chino-Malayan province:										
China	10,577	2,654	4,712	2,657	3,873	4,554	3,398	6,708	7,989	5,666
Tonkin (Indo-China)	378	284	284	452	112	129	150	189	92	(1)
Burma and Shan States	4,138	3,623	2,983	673	1,038	960	814	849	1,634	1,277
Siam	231	258	137	76	------	(2)	------	127	10	8
Unfederated Malay States	1,156	808	296	12	258	393	214	251	234	170
Federated Malay States	391	480	257	60	104	41	107	174	99	22
Netherland East Indies	7	------	161	80	------	10	165	27	9	(1)
Indian province: India (excluding Burma)	44	1	------	------	------	------	------	------	------	------
	18,651	8,879	9,005	4,010	5,399	6,087	4,848	8,325	10,086	(1)
AUSTRALIA										
Australian province:										
Queensland	357	344	119	5	4	------	1	5	1	3
Northern Territory	280	278	245	------	19	1	------	------	------	------
New South Wales	279	237	39	------	------	2	10	8	------	------
Victoria	5	3	9	------	------	------	------	------	------	------
Tasmania	440	379	209	12	21	116	64	207	98	176
Western Australia	6	8	3	------	------	------	------	------	------	(1)
	1,367	1,249	624	17	44	119	75	220	99	179
OCEANIA										
Oceanic province: New Zealand	170	146	47	46	------	15	18	36	15	(1)
SOUTH AMERICA										
Cordilleran province:										
Argentina	614	204	182	52	125	144	137	4	11	10
Bolivia	3,703	2,161	766	174	9	------	(4)	82	109	79
Peru	256	139	77	2	------	------	------	5	------	------
	4,573	2,504	1,025	228	134	144	137	91	120	89

[1] Data not available. [2] Less than one-fourth ton. [3] Estimated. [4] Less than one-half ton.

World production (as shown by sales or exports) of tungsten ore, 1918–1927, by metallogenic provinces and political areas, in metric tons of concentrates containing 60 per cent of WO_3—Continued

Province and area	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
NORTH AMERICA										
Southwest American province:										
Mexico	239	103	82	37	-------	-------	-------	-------	-------	--
United States	4,578	297	196	-------	-------	219	513	1,080	1,254	1,056
Alaskan province: Alaska	13	-------	-------	-------	-------	-------	-------	-------	-------	-------
Canadian province: Southeastern Canada	15	-------	-------	-------	-------	-------	-------	-------	-------	-------
	4,845	400	278	37	-------	219	513	1,080	1,254	1,056
EUROPE										
Scandinavian province:										
Norway	2	-------	-------	-------	-------	-------	-------	-------	-------	(1)
Sweden	3	30	5	-------	-------	-------	-------	-------	-------	(1)
Franco-Cornish province:										
England	307	177	83	81	3	2	2	1	20	12
France	45	70	23	-------	-------	-------	-------	(1)	(1)	(1)
Iberian province:										
Portugal	1,150	706	237	306	527	289	304	207	358	179
Spain	534	302	57	25	-------	9	161	26	123	164
Italy	(1)	(1)	-------	7	-------	1	-------	-------	-------	-------
Erzgebirge province:										
Germany	196	145	45	27	42	40	13	161	-------	-------
Czechoslovakia	(1)	70	48	35	28	28	66	60	86	(1)
Russian province: Russia	25	5	(1)	(1)	(1)	(1)	(1)	9	[5] 63	(1)
	2,262	1,505	498	481	600	369	546	464	650	(1)
AFRICA										
South African province:										
Southern Rhodesia	37	20	17	17	44	-------	22	22	-------	33
Union of South Africa	37	9	-------	-------	-------	-------	-------	-------	-------	-------
Nigeria	(1)	32	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	74	61	17	17	44	-------	22	22	-------	33
	31,942	14,744	11,494	4,836	6,221	6,953	6,159	10,238	12,224	(1)

[1] Data not available.

[5] Year ended Sept. 30.

EVENTS OF THE YEAR

The duty on tungsten attracted attention, and steps directed both toward lowering and raising the duty were suggested. The duty now imposed under paragraph 302 of the tariff act of 1922 is 45 cents per pound on the contained metallic tungsten, equivalent to $7.14 per short-ton unit (20 pounds of tungsten trioxide, WO_3). On tungsten in "ferrotungsten, metallic tungsten, tungsten powder, tungstic acid, and all other compounds of tungsten, 60 cents per pound on the tungsten contained therein and 25 per centum ad valorem; ferrochromium tungsten, chromium tungsten, chromium cobalt tungsten, tungsten nickel, and all other alloys of tungsten not specially provided for, 60 cents per pound on the tungsten contained therein and 25 per centum ad valorem."

Paragraph 305 of the same act imposes a duty in addition to the rates of duty provided for in this schedule as "steel in all forms and shapes" containing more than six-tenths of 1 per cent of tungsten, 8 per cent ad valorem, and 72 cents per pound on the tungsten content in excess of the six-tenths of 1 per cent "on any material provided for in paragraph 304, containing molybdenum and tungsten." Paragraph 304 refers to duties on steel which vary from 0.2 cent to 20 per cent ad valorem. The higest rate would include most tungsten-bearing steels.

Some foreign tungsten-bearing steel scrap was imported during the year, but other tungsten-bearing scrap had been held up since 1925 on the contention that it should be subject to a duty as tungsten steel. The test case was made on turnings from steel carrying 14.5 per cent tungsten, fit only for remanufacture, and sold for less than 7 cents a pound. The tungsten content was not guaranteed by the seller. The collector of the port of New York decided that it was enterable as scrap steel under paragraph 301 of the tariff act of 1922, which allows the entry of "wrought and cast scrap iron and scrap steel, valued at not more than 7 cents per pound, 75 cents per ton: * * * *Provided*, That nothing shall be deemed scrap iron or scrap steel except secondhand or waste or refuse iron or steel fit only to be remanufactured," but the Board of General Appraisers in 1925 decided that it was dutiable as a "compound of tungsten." The Court of Customs Appeals reversed the board's opinion in a decision published April 21, 1927.

In January the United States District Court of the State of Delaware declared to be invalid a considerable part of the claims in the Coolidge patent (assigned to the General Electric Co.) on which the manufacture of tungsten filaments is based.

It is probable, however, that at this time the manufacturers of tungsten lamps, radio tubes, and similar articles depend as much on getting and holding the mass of trade through a superior product, which they are enabled to make by care and perfection of technique, as on patents. The enormous size to which the tungsten incandescent-lamp industry has grown is shown by figures for 1926, given in the report of the lamp committee to the National Electric Light Association at its meeting at Atlantic City, N. J., June 6 to 10, 1927.[43]

> During 1926 there were sold in the United States a total of 294,000,000 large Mazda and tungsten filament lamps, an increase over the preceding year of 11.8 per cent as compared with an increase in 1925 over 1924 of 0.76 per cent.
>
> These figures do not include miniature lamps, flash-light lamps, Christmas-tree lamps, automobile lamps, etc. It has been reported to the committee that the amount of sales of these types of lamps in the United States, including imports, during 1926, was as follows:

Tungsten filament:	
Flash light	32,700,000
Automobile	116,300,000
Christmas tree	34,350,000
Miscellaneous	4,990,000
Total tungsten filament	188,340,000
Carbon filament:	
Christmas tree	12,680,000
Miscellaneous	1,030,000
Total carbon filament	13,710,000
Grand total	202,050,000

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[43] National Electric Light Association, Publications 267-66: Released June 7, 1927, p. 1.

It will be noted that the sales of miniature lamps used for Christmas-tree lighting, this being the only one of the miniature type connected to central-station lines, amounted to tungsten filament, 34,350,000; carbon filament, 12,680,000; or a total of 47,030,000. When it is remembered that the current consumption of eight Christmas-tree lamps amounts to approximately the same as one 40-watt lamp, it will be seen that the sales of lamps for Christmas-tree lighting during 1926 were approximately the equivalent of 6,000,000 40-watt lamps.

Of the 18,500,000 carbon lamps [including the miniature lamps shown in the preceding table] sold during 1926 it is estimated that they were purchased for the following uses: 500,000 for heating purposes, indicator lamps, resistances, etc.; 2,000,000 for use requiring ruggedness or ability to withstand shock and vibration; 16,000,000 because of the low first cost of the lamp or because of unusual shape or decorative character of bulbs.

In the first group—namely, lamps sold for heating purposes, indicator lamps, resistances, etc.—the question of lamp efficiency is not of particular importance where a lamp is used for heating or resistance purposes. Lamp efficiency is, however, of importance in the case of indicator lamps, and as Mazda lamps are available for such purposes your committee recommends their use.

With regard to the second group—that is, lamps purchased for use requiring ruggedness or ability to withstand shock and vibration—the "rough-service" Mazda lamp has been developed to meet this demand.

HARD TUNGSTEN ALLOYS

A development in the use of tungsten that has been attracting little notice is the use of very hard tungsten compounds for drilling in rock, especially oil-well drilling. The most extensive use seems to have been in southern California.

Tungsten carbide under various trade names has been used considerably in small short rods or grains and is said to have sold at $200 to $400 per pound. The carbide alone is too porous and brittle to be useful and is fused with enough iron and cobalt to make it solid and much tougher. It has been sold under the names "volomite," "triamant," and numerous others and is said to have been mostly imported.

Analyses of tungsten alloys made by Los Angeles companies are reported to have shown the following compositions:

	Per cent			Per cent	
Tungsten (W)	20.22	40 to 84	Silicon (Si)	0.22	
Chromium (Cr)	17.40	4.0	Titanium (Ti)	None.	4 to 15
Manganese (Mn)	1.63	None.	Cerium (Ce)	None.	1 to 5
Carbon (C)	2.41	2 to 4	Iron (Fe)	[1]	3 to 4

[1] Remainder.

Both types of alloys are cast. The alloys and carbide are welded to the edge of the drill bits. Stellite is also used for the cutting edges.

The exceeding hardness of tungsten carbide, said to be more than 9 on the Mohs scale, in which the diamond is taken as 10, seems to indicate a future development of its use.

MOLYBDENUM IN ORE

As many steel makers know, the scheelite concentrates from the contact metamorphic deposits 20 miles northwest of Bishop, Calif., carry 3 to 4 per cent of molybdenum, and the proportion of the molybdenum to the tungsten is about 1 to 21. Some Nevada contact metamorphic scheelite concentrates also carry a little molybdenum. Analyses of ferrotungsten made from the two concentrates showed:

From California, tungsten, 85.08; molybdenum, 4; silicon, 0.14; and carbon 0.07 per cent; and from Nevada, tungsten, 80.22; molybdenum, 0.28; silicon, 0.53; carbon, 0.77 per cent. Three steels were made by the United States Bureau of Standards, in one of which a ferrotungsten thought to be free from molybdenum was used. The finished steels had the following compositions:

Number	C	Mn	P	S	Si	Cr	W	V	Mo
E 108	0.66	0.26	0.027	0.012	0.09	3.90	18.25	1.12	0.08
E 107	.67	.23	.021	.010	.06	3.66	17.56	1.06	.83
E 109	.61	.18	.027	.009	.04	3.34	15.44	.81	.74

Life tests made by rough turning 3½ per cent nickel steel and working characteristics (casting, forging, and rolling) were practically the same for the three steels.[44]

PROPORTIONATE USE IN HIGH-SPEED STEELS

Of interest, as showing something of the use of tungsten in the steel trade, is an estimate of proportionate uses by H. E. Nichols, president of the Atlas Steel Corporation, in a letter dated August 2, 1928. He estimates that 20,000,000 pounds of high-speed steel[45] is made annually in the United States, divided about as follows as to uses:

	Per cent
1. Twist drills, reamers, counterbores, and formed tools of this type	30
2. Cutters, hobs, mills, and formed tools of this type	25
3. Disks, punches, etc	15
4. Turning tools, lathe, planer, shaper, boring tools, etc	20
5. Other uses	10
	100

ECONOMIC VALUE OF TUNGSTEN

No other metal produced in such small quantity has the industrial importance and has such an influence on the comfort of people at large as tungsten. Its use in incandescent lamps in place of the carbon filament which it superseded saves large quantities of electricity. To have produced the artificial light used in the United States in 1927 by lamps having carbon filaments would have necessitated an added expenditure of two billions of dollars.[46] It gives a quality of light otherwise practically unattainable; and on account of these qualities it has made possible the lighting of small isolated buildings, mines, ships, trains, and automobiles on a par with lighting systems connected with large central plants.

Tungsten has made practicable the flash light and a Röntgen-ray (X-ray) tube generating rays so hard that almost instantaneous roentgenographs of the body can be taken. The hard rays (rays of very great penetration) make possible the study of molecular and crystal structures, the value of the knowledge of which is only beginning to be realized, and also make possible study of the interior of metal and other masses, showing bubbles, inclusions, and other forms of weakness or inhomogeneity otherwise undetectable except by the destruction of the specimen.

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[44] Letter, George K. Burgess, Director, Bureau of Standards, to Nelson Franklin, Aug. 20, 1927.

[45] Steel of about the type shown in the analyses quoted.

[46] Fuller, T. S., Less-Common Elements in the Electrical Industry: Am. Inst. Min. and Met. Eng., Preprint, 1928, p. 5.

For all these uses not more than a hundred tons of concentrates carrying 60 per cent WO_3, valued at $60,000 to $65,000, is used per year. Most tungsten, however, is used in tool steels for forming metals, and here, although not so readily noticeable, the savings in labor, time, machinery, and consequent investment of funds are very great. As has been said often, one man with one lathe and tungsten-steel tools can do as much work as five men with five machines and carbon-steel tools.

One automobile manufacturer making a high-priced car said that if he had to use the old carbon tools it would increase costs $200 per car. If on the 4,000,000 cars made annually in this country a saving of only $50 per car were made, it would mean a saving of $200,000,000 annually, and much more if costs of extra machinery and housing were included, and, as a matter of fact, the saving is probably very much more.

What is true of automobile building is true of all other shop practice where steel and iron must be turned, planed, drilled, or otherwise cut, and savings in such shops must amount to $200,000,000 or $300,000,000 more on a consumption of tungsten concentrates not exceeding 3,450 tons carrying 60 per cent WO_3, a total for the electrical industry and machinery trade of about 3,500 or 3,600 tons, costing about $2,200,000 to $2,275,000, of which about $1,500,000 is duty, so that the real cost of the tungsten concentrates is only about $700,000 to $775,000. Probably the total saved by this tungsten, worth (as concentrates at the world's price) about three-quarters of a million dollars, in the United States is not less than two and a half or three billion dollars annually. In addition, the use of tungsten permits the manufacture of innumerable conveniences, comforts, and luxuries, including, besides those already mentioned, radio tubes, electrical contacts, airplane and automobile valves, phonograph needles, and others. The importance of tungsten among the metals in our type of civilization is comparable with that of lead and zinc and is exceeded only by that of iron and copper.

In time of war the importance of tungsten is still greater. As has been said in these chapters before, it is improbable that shells and other cut steel could have been supplied in the Great War in the quantities needed had tungsten tools not been available. It would probably have been impossible to find the men, machines, and shop room necessary to turn out the indispensable munitions in the time available.

During the Great War the United States was unable to supply its own needs for tungsten ore, no matter what the price paid. Should such another catastrophe happen, this country would be still less able to dig its own supply from its own territory. The best of the known deposits, that at Atolia, ceased work under prices ranging between $10 to $11 per unit, although it once made money at half the price.

The fact is that the United States has no tungsten resources at present world prices. That tungsten mining is carried on at all is due to one of the highest duties ever levied by this Government—the highest duty it ever placed on a raw material.

BIBLIOGRAPHY

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Ahlfeld, F. Los yacimientos de wolfram en Bolivia. Rev. Minera de Bolivia, Oruro, Año 2, No. 8, 1927, pp. 225–237. Map.

———. Die Wolfram und Antimonerzvorkommen Boliviens. Ztsch. prak. Geol., vol. 35, 1927, pp. 145–152.

Canadian Westinghouse Co. Tungsten powder manufacture. Canadian Patent 275,882, November 29, 1927. Canadian Pat. Off. Rec., vol. 55, November 29, 1927, p. 2708.

The method of obtaining tungsten powder of fine grain or particle size which comprises mixing with purified tungsten oxide between about 0.1 per cent and about 1 per cent of a compound containing cesium and reducing the oxide by means of hydrogen at an elevated temperature. The method of obtaining tungsten of varying grades of coarseness which comprises mixing with tungsten oxide varying percentages of a compound containing lithium and reducing the oxide by means of hydrogen at an elevated temperature. The method of obtaining tungsten of varying grain or particle size which comprises mixing tungsten oxide with a compound containing an alkali metal, the atomic weight of which latter is inversely proportional to the desired grain size, and reducing the oxide by means of hydrogen at an elevated temperature.

Chemical Engineering and Mining Review. Rare Metals. Vol. 19, January 5, 1927, p. 137.

The value of wolfram, molybdenite and bismuth produced by these fields (North Queensland) has run into millions of pounds sterling, and the way in which they have been neglected in regard to roads is disgraceful. Wolfram Camp is about 16 miles from Dimbula, on the Chillagoe railway, and the road is in such a scandalous condition that one can not go there by motor, and by buggy it takes four hours at least to cover the distance. Bamford is more favorably situated, being only 4 miles from Petford on the railway line, but no credit can be given to either the government or shire council for this. Mount Carbine is another rich rare metal field. These metals occur usually in greisenised granite near the contact of the intrusive granite with the intruded metamorphic rock and porphyry. Scheelite has been profitably worked at Mount Carbine with wolfram and molybdenite and at Percyville in pegmatite veins with gold.

Cissarz, A. Uebergangelagerstätten innerhalb der intrusivmagmatischen Abfolge. Teil 1. Zinn-Wolfram und molybdän Formationen. Neues Jahrb. Min.

Dengin, G. P. (Tungsten.) Mineral Resources of U. S. S. R., part 12, Leningrad, 1927, 69 pp., 13 text figs. (In Russian.)

Discusses deposits in Transbaikalia, the Urals, Western Siberia, the Far East, the Caucasus.

Dyson, G. Malcolm. The metallurgy and uses of tungsten. Chem. Age (London), vol. 16, May 7, 1927, p. 33.

Gives details of the reduction of tungsten from its ores and describes in a general way the manufacture of tungsten bronzes.

Eegriwe, Edwin. (A sensitive color test for antimony and for tungsten.) Ztschr. anal. Chem., vol. 70, 1927, pp. 400–403. Chem. Abs., vol. 21, 1927, p. 1779.

Fehse, W. (Tungsten helix furnaces for high temperatures.) Ztschr. tech. Physik, vol. 8, 1927, pp. 119–122. Chem. Abs., vol. 21, 1927, p. 1934.

Tungsten tubular helical furnaces were constructed with ignited ZrO_2 (m. p. 2,700°) or fused Al_2O_3 (m. p. 2,000°) as filling material and without an inner porcelain tube. The furnaces can be used up to 2,200°; drawings and construction details are given for four different types.

Field, B. E., and Franks, R. Wear-resisting alloy. U. S. Patent 1626726, 1927.

An alloy which is suitable for making bearings or gages or other articles which are subject to abrasion contains iron together with tungsten 1 to 12, chromium 25 to 35, boron 0.10 to 1.0, and carbon 1.0 to 3.5 per cent.

Foulke, T. E. Metal filaments. U. S. Patent 1628456, May 10, 1927.

Tungsten wire is passed through a furnace at 950°, so that a film of oxide is formed on it, and is then coated with a "getter."

Gregory, Margaret Ada. Titanium, tungsten, and tantalum. Canadian Patent 274670, October 18, 1927. Canadian Pat. Off. Rec., vol. 55, October 18, 1927, p. 2335.

A process for the treatment of ore with acid for the recovery of titanium, tungsten, and tantalum, according to which the ore, in finely divided form, is mixed with enough carbon to reduce the iron present from oxide to metal and with a fusible alkali salt; the mixture is heated to bright redness in a closed vessel or in a neutral or reducing atmosphere, and finally the mass is treated with a weak acid. A process for the treatment of ore with acid for the recovery of titanium, tungsten, and tantalum, according to which 100 parts of ilmenite is mixed with 20 parts of powdered charcoal and 20 parts of soda ash, heated in a closed chamber to bright redness, then heated with enough 2 per cent sulphuric acid to neutralize the soda and form with the iron ferrous sulphate and a slight excess to render the liquid faintly acid, and finally raised to and maintained at the boiling point for one hour.

Hertz, G. L. Manufacture of very thin wires. U. S. Patent 1627971, May 10, 1927.

Wires of metals such as W, Sn, Zn, Bi, Cd, Tl, or Pb are reduced in diameter by connecting them as cathode in a glow discharge of suitable current density to cause disintegration.

Jennsen, H. I. Tin area of the far North. Great dividing range between Cairns and Cooktown. Ind. Australian and Min. Stand., vol. 78, 1927, p. 407.

Mineral distribution.—Tin is found principally in and around the granite in the alluvial form derived, as already mentioned. It is seldom found as veins in metamorphosed rock in this region. Wolfram is common in the contact zone, both within the granite and in the intruded schist. Scheelite is confined practically to the schistose rocks near the granite contact. These minerals can be found in many gullies along the foot of the range.

Mount Carbine is a well-known center of wolfram and scheelite mining. It has been well described by L. C. Ball. Mount Alto, about 2 miles southwest of Mount Carbine, is shedding tin into numerous gullies and in some parts wolfram as well. The minerals are shed by pipes and quartz veins.

Jones, H. A., Langmuir, Irving, and Mackay, G. M. J. The rates of evaporation and the vapor pressures of tungsten, molybdenum, platinum, nickel, iron, copper, and silver. Phys. Rev., vol. 30, 1927, pp. 201–14.

Jones, H. A., and Langmuir, Irving. The characteristics of tungsten filaments as functions of temperature. Gen. Elec. Rev., vol. 30, 1927, pp. 354–362. Chem. Abs., vol. 21, p. 2105.

Keen, W. H. Alloy steel. U. S. Patent 1621886, 1927.

An air-hardening forgeable high-speed steel contains V 3, CO 0.85 or more, W approximately 18, and Cr approximately 4 per cent.

Kenty, Carl, and Turner, Louis A. Surface layers on tungsten produced by active nitrogen. Nature (London), vol. 120, 1927, p. 332.

"We have found that a fine tungsten filament at a very dull-red temperature placed in a stream of nitrogen undergoes a considerable (10 to 25 per cent) lowering of its resistance (for constant current flowing through it) when active nitrogen produced upstream by a condensed discharge passes over it."

Koref, F., and Alterthum, H. Preparation of metals with high-temperature fusing points, such as tungsten, and of wire therefrom. U. S. Patent 1650631, 1927.

Powered tungsten is compressed, sintered into a large crystal in an atmosphere of reducing gas, and worked while still hot into a flexible and ductile state.

Koref, F., and Hoffman, H. Preparing metals. U. S. Patent 1617161, 1927.

A single crystal is built up to a larger size by deposition of the same kind of metal from a gaseous atmosphere at a rate so limited as to avoid the formation of small crystals. For the deposition of tungsten an atmosphere of tungsten hexachloride and hydrogen may be used at a temperature of about 1000° C.

Koref, F., and Moers, K. Working refractory metals. U. S. Patent 1635793, 1927.

A refractory metal such as tungsten in a single crystal is repeatedly and successfully deformed "short of the beginning of recrystallization" under conditions favorable to the interlinkage of the macrocrystals, which effects hardening of the metal, and the metal is thereafter heated to reduce its hardness

Laise, Clemens A. Refractory metal product and process of making same. (Filament alloy.) U. S. Patent 1631493, 1927.

The method consists of mechanically working metallic bars of tungsten or tungsten alloys containing refractory nitrides (boron nitride is used, although tantalum, titanium, and zirconium nitrides are said to give good results) at yellow and red heats with intermediate annealings, thereby reducing size of said bars by hammering and drawing processes to about 40 millimeters diameter; then heating the resultant wire in an atmosphere containing oxygen so as to form a compact coating of refractory oxide on same and further annealing said coated wire so as to produce a ductilizing effect on the metallic core; then dissolving the oxide coating in an alkali solution and drawing the wire down to finer sizes, using hot circulating lubricants on the wire during the drawing operation. Less than 1 per cent of potassium borate or silicate is also added, so that the filament contains 1 to 20 per cent of boron nitride and less than 1 per cent of a tungsten bronze.

Laissus, J. (New researches on the cementation of ferrous alloys by chromium and tungsten.) Rev. métallurgie, 1927, pp. 345–352.

Ledig, K. K. Alloy for pen points. U. S. Patent 1647301, 1927.

Sixty parts of molybdenum is alloyed with 10 parts of tungsten, 10 parts of rutile, and 20 parts of an alloy containing nickel (70 per cent) and copper (30 per cent).

Liebmann, A. J. Tungsten contact-breaker arm. U. S. Patent 1650897, 1927.

A tungsten contact is brazed to a steel support by an intervening layer of brazing material such as copper.

Liempt, J. A. M., van. Production of metallic single crystals. Am. Inst. Min. and Met. Eng. Tech. Pub. 15, 1927, 8 pp.

A mixture of tungsten hexachloride and hydrogen brought in contact with a glowing wire gives a single crystal deposit of tungsten. Single crystals of molybdenum, tantalum, iron, zirconium, and titanium have been prepared in a similar way. The author prepared a single crystal wire of tungsten by depositing tungsten on a tungsten-cylinder cathode, using molten sodium tungstate as electrolyte. Two recrystallization methods are described: (1) Formation of one large crystal at the expense of smaller ones when the metal is held near the melting point and (2) heating a metal under strain (Sauveur). Such treatment produces large single crystals. Small tungsten crystals when subjected to heat at 3,268° in an atmosphere of moist hydrogen will grow into a single crystal.

Lindner, Kurt. (Space configurations of halogen derivatives of bivalent molybdenum, tungsten, and tantalum.) Ztschr. anorg. allgem. Chem., vol. 162, 203–221, 1927. Chem. Abs., vol. 21, 1927, p. 1601.

Lucas, F. F. Alloy. U. S. Patent 1628990, 1927.

A steel suitable for submarine cable armor contains nickel 7 to 20, "a tungsten-like metal" 7 to 10, chromium 6 to 8, manganese 2 to 7, and carbon 0.5 to 0.6 per cent.

Marden, John Wesley, Thomas, Thomas Philip, and Conley, John Edward. Activation by means of hydrogen-free, carbon-bearing gas. U. S. Patent 1626685, 1927.

A method of treating thoriated tungsten filaments with carbon monoxide, cyanogen, or other carbon-bearing gas free from hydrogen. By this method part of the thorium oxide is reduced to elemental thorium.

Miller, W. L. Apparatus for forming tungsten filaments. U. S. Patent 1638868, 1927. Chem. Abs., vol. 21, 1927, p. 3165.

Mining Journal (London). Tin and wolfram mining in Spain. Vol. 160, January 7, 1928, p. 5.

"A writer in the 'Boletin Minero' gives some particulars concerning the tin deposits in Spain which are to be developed by the Société des Etains de Silleda, a French company floated recently with a capital of 4,000,000 francs (Min. Jour., October 22, 1927). The deposits are situated near the township of Silleda, in the Province of Pontevedra, and comprise the Tiro, the Sidon, and other concessions, which were operated years ago by a British concern, work having subsequently been suspended for reasons unknown to the writer. The undertaking has been taken over by the newly constituted French company, who propose to develop actively the work begun by their predecessors. Tin and wolfram are present in a zone which extends through the ayuntamientos of Lalin, Carbia, Silleda, and Forcarey, and is a continuation of the zone running through Orense, Beariz, and Avion, the whole of it being possibly in relation with the zone observed in the Noya sector, on the east side of Coruña, in which the deposits are of similar nature and formation. The Tiro y Sidon and Angelita groups contain, respectively, cassiterite and wolfram, and wolfram only, in lodes of quartz occurring in granitic formation. The production in 1917 was 43 tons tin and 75 tons wolfram for the first group and 63 tons wolfram for the second. The writer adds that indications of these ores are frequently met with in the regions mentioned and have given rise to numerous claims and capital investments which do not appear to have been adequate for a general survey of the properties."

Morgan, P. G. Minerals and mineral substances of New Zealand. Geological Survey of New Zealand. Bull. 32, 1927, 110 pp. 2 maps.

A catalogue of the minerals and mineral substances occurring in New Zealand, arranged in alphabetical sequence. Scheelite, pages 90 to 91; wolframite, page 107. Scheelite has been found at numerous places and to the end of 1925, 2,371 long tons of concentrates had been produced. First mined in 1881. Wolframite is of only mineralogical importance. The literature is listed.

Pacz, Aladar. Alloy filament. U. S. Patent 1635055, 1927.

A filament for incandescent lamps consisting of tungsten with less than 1 per cent of zirconium and a process of producing metal filaments, which consists in mixing tungsten oxide, zirconium oxide, a reducing agent, and silica, reducing the said mixture to metal, and then working the metal down to filamentary form.

Salmony, A. (The production of tungsten incandescent lamps by purely mechanical means.) Chem. Zeit., vol. 51, 1927, pp. 389–391.

The operation of the Siemens & Halske Osram works is described.

Scrivenor, J. B., and Shenton, J. C. Thorotungstite. Am. Jour. Science, 5th ser., vol. 13, 1927, pp. 487–490.

Describes a mineral found in honey-yellow crystals and in masses in float fragments at Pulai in the Kinta district of Perak. It proved to be a hydrated oxide of tungsten, thorium, cerium, and zirconium for which the formula suggested is $2WO_3.\ H_2O + (ThO_2, Ce_2O_3, ZrO_2).H_2O$.

Shimer, W. R. Steel of high-temperature stability. U. S. Patent 1624075, April 12, 1927.

A low-carbon, tough, readily workable steel suitable for use at high temperatures contains chromium 0.40 to 0.60, manganese 0.50 to 0.80, and tungsten 1.0 to 1.5 per cent.

Slessor, Robert. Metal mining in China. Chem. Eng. and Min. Rev., vol 20, 1927, pp. 11–15.

The production of tungsten in China was due to the war. Previously no deposits were worked. It was first mined in the Ya Kwong Si Mountain in Hunan on the border of Hunan and Kwangtung, where it was discovered by a coolie on the waste dump of the old arsenic mines, which had been worked since the Ming dynasty (1600), and some 20,000 to 30,000 tons of waste rock had accumulated. Wolframite which was associated with the mispickel was thrown out as useless. The original arsenic mine was at the top of a mountain, but only an open cut filled with water is now visible, together with the débris and a few batteries of arsenic furnaces. In the deposit now worked by the Shin Yu Co. a well-defined quartz vein can be followed up the slope of the hill for about 3,000 feet. The vein has been opened up by 15 horizontal tunnels. Tungsten ore occurs all through the quartz in patches and vugs. It is mixed with mispickel, which is picked out when hand sorted at the surface. The ore is roughly hand picked in the tunnel and carried down to washing sheds at water conserved behind small dams. After the large lumps of ore have been cobbed the rest is crushed by hammers and washed in close-woven baskets. The ore is then taken down to the company's main offices in the village at the foot of the hill. There it is crushed to about millimeter size and rewashed, weighed, and packed in wooden boxes holding about 56 pounds each. The ore assays 65 to 70 per cent tungstic trioxide and rarely contains more than 1 per cent tin, but carries up to 5 per cent of arsenopyrite. The average grade of the ore before hand sorting is 3 to 5 per cent "wolfram." The system of working by numerous tunnels enables the company to have a large number of faces open at the same time, so that although one party may have a poor month the average output is kept up. The output from the 15 tunnels, employing about 100 men, was about 25 tons of tungsten concentrates monthly. The industry is much hampered by the exactions of the officials and soldiers, not only at the source but all the way along the road by land or water. The concentrates exported had a content of tungstic trioxide, 71.05 per cent; ferrous oxide, 10.08 per cent; manganese oxide, 10.93 per cent; silica, 2.55 per cent; tin oxide, 0.98 per cent; phosphorus (?), 0.04 per cent; copper, 0.011 per cent; arsenic, 2.1 per cent; sulphur, .1 per cent. The methods employed for dressing preclude poor ores being worked. Thus ores with less than 2 per cent "wolfram" can not be profitably mined here, and the lowest ore actually worked is about "3 per cent in wolfram." An average ore would be one of 4 per cent recovery. The tailings, however, contain at least 2 per cent of "wolfram," which is at present run to waste down the hill into the creek. The Chinese production for 1922, 1923, 1924, and 1925 amounted to 19,668 tons. The production in 1925 was 5,868 tons, most of which came from detrital deposits in the Quee Mee Mountain district in South Kiangsi. Civil disturbances prevented the usual output from the Hunan border.

Smith, G. O. Alloys for springs resilient at high temperatures. U. S. Patent 1634343, 1927.

Springs which are resilient even at temperatures of redness are formed of copper 30 per cent or less, a metal of the iron group 60 to 95 per cent, and a metal of the tungsten group 5 to 40 per cent; for example, various alloys of cobalt, chromium, tungsten, nickel, iron, manganese, molybdenum and copper are suitable for springs for holding filaments of vacuum tubes.

Smithells, C. J. Tungsten, a treatise on its metallurgy, properties, and applications. Vol. 167, New York, 1927, p. 156. Text figures.

An excellent treatise.

Someyea, Kin'ichi. (The use of liquid amalgams in volumetric analysis. IX. Some new methods for the determination of vanadium and tungsten.) Ztschr. anorg. allgem. Chem., vol. 163, 1927, pp. 206–213.

I. Iodometric determination of vanadium: By means of liquid zinc amalgam it is easy to reduce vanadic acid to the bivalent vanadous condition in the presence of dilute hydrochloric acid or sulphuric acid. Then, if an excess of 0.1 normal iodine solution is added and the solution is neutralized by adding sodium bicarbonate, the vanadium is oxidized back to the quinquevalent state in about 15 minutes with frequent shaking in dispersed sunlight. The excess iodine can be titrated with thiosulfate.

II. Titration of tervalent tungsten chloride with copper sulfate solution: In the presence of strong hydrochloric acid tungsten can be reduced to the tervalent state by bismuth amalgam and the tungsten can be oxidized back by means of 0.1 molal copper sulphate. The end point is shown by the yellow color of the solution exactly as in the titration of $SnCl_2$ with $FeCl_3$.

III. Reduction of vanadic acid with lead amalgam and subsequent titration with dichromate: In the presence of concentrated hydrochloric acid, Pb–Hg reduces vanadic acid completely to the bivalent vanadous state. Zinc amalgam can also be used. Then, on adding an excess of copper sulphate solution the vanadium can be oxidized to the quadrivalent vanadyl state and the resulting cuprous chloride can be titrated with dichromate using diphenylamine as indicator. Good results are obtained if the amount of copper salt added and the concentration of the hydrochloric acid at each stage of the process are properly regulated.

Thompson, J. G. Steels best for nitrogen fixation. Iron Age, vol. 120, 1927, pp. 1518–1520.

The apparatus used for nitrogen fixation should not deteriorate when exposed to hydrogen, nitrogen, or NH_3 at 500° under 1,500 atmospheres pressure. Wrought iron, mild steel, copper, and nickel all fail rapidly under these conditions. Tests of various alloy steels containing up to 1.5 per cent chromium or 5 per cent nickel showed 2 types of failure, a uniform decarbonization and a deep intergranular fissuring. A tungsten-chromium steel was the least affected. The deterioration was probably due, first, to hydrogen, which allowed access of NH_3 to the interior of the steel, forming unstable nitrides, except in the high chromium steels, where the more stable nitride of chromium seemed to have a protective influence.

Wagner, P. A., and Rogers, A. W. The geology of the northeastern part of the Springbok Flats and surrounding country. Univ. South Africa Dept. Mines and Ind. Geol. Surv. No. 17, Pretoria, 1927, pp. 83–85.

Scheelite and wolframite are found with cassiterite, copper, arsenic, and bismuth minerals in deposits that have replaced granites and quartzite in the Mutue Fides-Stavoren tin fields. The quantity of tungsten minerals is small.

Warren, H. W. H., and Newbound, R. Electric resistances. British Patent 252537, 1925.

A coil of nichrome or similar wire wound on a rod of carborundum or like refractory material is imbedded in an envelope of heat-insulating material such as carborundum which is mixed with a binder such as clay. The rod or envelopes may also be mixed with nickel or tungsten powder.

RADIUM, URANIUM, AND VANADIUM

FOREWORD

The history of radium and uranium during 1927 is again a short story. Belgium still dominates the market, and deposits in the United States can not be profitably worked. The use of radium has not decreased, so far as can be learned, but the use of Röntgen rays following the invention of greatly improved tubes and technique has possibly limited the sale of new radium. The use of uranium in glass seems to have increased somewhat. Alone and in combination with other elements beautiful colors are made both in glass and glazes.

The scientific interest in uranium and its descendents, radium and uranium lead (radium G), and like members of the greatly similar family thorium, mesothorium, and thorium lead (thorium E) is, however, still great, and they are already tools of importance in the hands of chemists, physicists, and geologists in solving problems in the age of rocks and the history of the earth.

Vanadium is still a standard component of steels and is finding important and increasing use as a catalyst.

RADIUM AND URANIUM

United States.—Only a little high-grade carnotite ore, carrying 4 to 8 per cent U_3O_8, was produced during 1927, and all was sold for use in vessels for radioactive drinking water, for making salves, and for other medicaments. The Yellow Circle Mining Co., of Moab, Utah, mined a little ore carrying about 8 per cent U_3O_8 from its claims near Cain Pass on the southwest side of the La Sal Mountains, Emery County, Utah. In the White Signal district, 9 miles south of Tyrone, N. Mex., Leach & Leach mined some ore carrying torbernite ($CuO.2UO_3.P_2O_5.8H_2O$) and autunite ($CaO.2UO_3.P_2O_5.8H_2O$). The minerals, which grade one into the other, are found distributed through greatly decomposed diabasic dikes, into which they were, of course, introduced subsequent to intrusion. In the same district the minerals are also found along cracks in a soft white rock that may have been a tuff. The ore is shipped to Chicago, where a firm has been formed to work the materials into medicaments.

More or less radium is contained in uranium minerals found in the sedimentary ores worked for vanadium, but this has not been saved. Henry A. Doerner, of the Rare and Precious Metals Experiment Station of the United States Bureau of Mines at Reno, Nev., has been conducting research to see if a cheap method can not be devised to save the radium as a by-product.

Although the United States is now producing no radium, several grams per year is being used in making watch and clock dials that are luminous in the dark. The imported radium is reported to retail at about $70,000 per gram.

South Australia.—The Australian Radium Corporation, N. L., which with an issued capital of £300,000,[47] attempted to work the radium deposits near Mount Painter, 88 miles east of Copley (375 miles from the treatment plant at Dry Creek, near Adelaide), has found trouble in operation.

The ores are apparently not in great quantity, only 700 tons having been developed in the principal (No. 6) workings. The ore as mined apparently carries only about 0.75 per cent U_3O_8. It is concentrated in a rough plant to a product carrying 2.6 to 3.8 per cent[48] U_3O_8. Some higher grade ore is found, but on the whole the grade is no higher and is probably lower than that of a number of American carnotite deposits. The deposits are in a desert, and the haul to the railroad is longer than in the United States. As American deposits will not pay for working it has been difficult to see how the Australian deposits could be made to pay. At the Dry Creek plant 50 milligrams of radium is said to have been extracted from 17 tons of concentrates.[49] Such an output would indicate an ore carrying less than 2 per cent U_3O_8.

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[47] Industrial Australian and Mining Standard, vol. 76, 1926, p. 97.

It was proposed to make titanium white from ilmenite found in the deposits at Radium Hill, 20 miles southeast of Olary, but ilmenite is a cheap mineral and its value is more than offset by the vanadium found in American carnotite deposits.

Belgian Congo.—So far as is known no mining for uranium ores was done during 1927 at Chinkolobwe, Katanga, where are located the deposits in the Belgian Congo, and no ore was treated in Belgium, although 20 grams of radium, presumably from stock, was sold by the Union Minière du Haut-Katanga. The same company naturally controls the greater part of the market for uranium salts, which find use in colored glass and pottery and in giving a creamy tint to building tile. The present annual output of the company is about 28,000 pounds of uranium pigments.

South Africa.—About the end of 1926 a discovery of pitchblende near Messina, in the extreme north of the Transvaal, was announced but nothing has been heard from it since. In 1927 uraninite was discovered in the Gordonia district, Cape Province. According to a report by Theo. Kassner, a copy of which was forwarded by William L. Kilcoin, assistant trade commissioner at Johannesburg, the uraninite is found in small stringers of black and greenish mica cutting gneiss and schists and connected with pegmatite dikes, of which there are many. The following analyses are given:

Analyses of uraninite from Gordonia district, Cape Colony, in per cent

	1	2	3
Uranium oxide (U_3O_8)	69.97	36.60	$\left\{\begin{matrix}[UO_3]\ 33.26 \\ UO_2\ 36.60\end{matrix}\right\}$ (U_3O_8) 73.46
Thorium oxide (ThO_2)	[1]14.75	18.05	12.17
Lead oxide (PbO)	9.94	8.90	8.52
Ferric oxide (Fe_2O_3)	2.39	3.60	.1
Alumina (Al_2O_3)	1.34		
Silica (SiO_2)	7.90	23.35	.70
Moisture and carbon dioxide	[2]4.20	7.30	[3]7.40
Other	(4)	[5]2.05	(6)

[1] Includes also rare earths.
[2] Includes also organic matter.
[3] Includes also loss on ignition.
[4] Sample also contained small amounts (less than 0.01 per cent) of the following elements: Mn, Zn, Ni, Ba, Ca, and S.
[5] CaO.
[6] Traces of rare earths.

1. C. R. Robson, analyst. The sample contained 1 pennyweight of silver per ton but no gold.
2. L. Heymann, analyst.
3. John Parry, analyst.

The "uranium ore content" of the rock is estimated from samples "procured along the strike of the occurrence from a few pit holes over a distance of 3 miles" to be 4 pounds per cubic yard. Such a content would be much lower than that in the carnotite ores of the United States or even of the South Australian ores and does not seem particularly promising.

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[48] Ward, L. Keith, Supplementary Report on the Prospects of the Mount Painter Deposits of Radium-Uranium Ore: South Australia Dept. Mines. Min. Rev. No. 45, 1927, pp. 57–58.
[49] Industrial Australian and Mining Standard, vol. 77, 1927, p. 434.

Czechoslovakia.—Although the famous old pitchblende mines at Jachymov (formerly St. Joachimsthal, Bohemia) were operated during 1926, the radium and uranium works were shut down to allow enlargement and improvement of the plant. From the mines 103 tons of uranium ore giving 22 metric tons of pitchblende, carrying 50 per cent U_3O_8 and thus presumably containing about 2.82 grams of radium, was produced. It was expected that the radium production for 1927 would be about 3 grams, although when completed the plant would have a capacity of 6 grams per year.[50]

The Government owns and operates the mines and has heretofore held the radium for research, educational, and clinical uses. Sales to private individuals through the government-owned Mining & Metallurgical Co. were begun in October, 1927.[51] The output of uranium compounds for ceramic colors is estimated at 13,000 kilograms (28,600 pounds) annually at prices ranging from $2.75 to $3 per kilogram.

Cornwall.—South Terras Mine, St. Stephens, the only Cornish radium mine, was not operated during 1927. It has a complete chemical plant for the treatment of the ore.[52]

MISCELLANEOUS ITEMS

Discoveries of uranium minerals were reported in Sweden,[53] France,[54] Western Australia,[55] and Canada,[56] but so far as known they were of no commercial importance.

The dangers of handling radium were emphasized by the death, in Pittsburgh, Pa., of Dr. G. D. Kammer, vice president of the Radium Dial Co. Dr. Kammer contracted anemia, which was attributed to his close contact with radium.[57]

IMPORTS

Uranium and radium salts imported for consumption in the United States, 1924–1927

Class	1924		1925		1926		1927	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Uranium oxide and salts of .... pounds..	12,550	$10,161	19,290	$18,553	53,411	$46,974	67,692	$58,971
Radium salts ...... grams [a]	8.1	408,146	9.27	462,095	10.97	548,788	7.259	393,140
Radioactive substances [b] ...... grams [a]			(c)	241	(d)	671	(d)	522
	....	418,307	....	480,889	....	596,433	....	452,633

[a] Bureau of Foreign and Domestic Commerce publishes quantities as follows: 1924, 125 grains; 1925, 143 grains; 1926, 169 grains; 1927, 112 grains.

[b] Classified in 1925 as "Bromide of mesothorium and radiothorium."

[c] 11.5 milligrams; recorded by the Bureau of Foreign and Domestic Commerce as 0.1771 grain.

[d] Weight not recorded.

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[50] Pilger, T., U. S. trade commissioner, Prague.

[51] Baldwin, Elbert, U. S. commercial attaché, Prague.

[52] Mining Journal (London), vol. 160, 1928, p. 4.

[53] von Struve, H. C., U. S. Consul, Göteborg, Sweden. Excerpt from Review of Commerce and Industries of the Consular District of Göteborg, Sweden, for the quarter ended Mar. 31, 1927. Consular Rept., Apr. 27, 1927.

[54] L'Echo des mines, vol. 55, p. 343, Paris, 1927.

[55] Industrial Australian and Mining Standard, "Radium in Western Australia": Vol. 77, 1927, p. 406.

[56] Ellsworth, H. V. See bibliography, p. 444.

[57] The Crucible (Pittsburgh), "Glenn Donald Kammer": Vol. 11, 1927, p. 156.

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Besides the articles referred to in the text, the following articles which may have some practical interest have appeared or become available during 1927:

Behounek, Franz. (The radioactivity of the four uranium pitchblende mines of St. Joachimsthal, Bohemia.) Physikal. Ztschr., vol. 28, 1927, pp. 333–342.

Shows that the radioactivity of water depends more on the radioactivity of the country rocks than on local concentrations in veins.

Bleecker, W. F. Glass. U. S. Patent 1629648, 1927.

A transparent, henna-colored Pb glass is formed from sand 75, Na_2CO_3 80, PbO 70, borax 20, KNO_3 30, and U oxide 4 to 24 parts.

Broughton, A. C. Mount Painter radium deposits. Outlook for the field. Ind. Australian and Min. Stand., vol. 77, 1927, p. 454.

Not encouraging.

Cervi, A. Activating liquids with radium emanations. U. S. Patent 1635113, 1927.

Da Silva, A. Mario. (A new determination of the period of polonium.) Compt. rend., vol. 184, 1927, pp. 197–199.

Determines the period of polonium as 140 days.

Dyson, G. Malcolm. Radium and uranium: Extraction, properties, and uses Chem. Age (London), vol. 17, Metallurgical Section, 1927, pp. 25–27.

A compilation of general scope. Quotes two schemes for the isolation of radium from ores.

Ellsworth, H. V. I. Uranothorite from the MacDonald Mine, Hybla, Ontario. II. Alpha and beta hyblite—new sulfatic alteration products of the Hybla thorite. Am. Miner., vol. 12, 1927, pp. 368–372.

———. A mineral related to samarskite from the Woodcox mine, Hybla, Ontario. Am. Miner., vol. 13, 1928, pp. 63–65.

———. A new analysis of the Maberly, Ontario, euxenite. Am. Miner., vol. 12, 1927, pp. 365–367.

Four new uranium and thorium minerals found in very small quantities are described, and three of Ellsworth's elaborate, painstaking analyses are given.

Failla, G. The development of filtered radon implants. Am. Jour. Roentgenology and Radium Therapy, vol. 16, 1926, pp. 507–525.

Has developed a method for collecting radon (radium emanation) in pure gold tubes, which are to be implanted permanently in tumor tissue. Details experiments to determine the proper thickness of the gold.

Fischer, A. Radioactive materials. British Patent 238347. Metal Ind. (London), vol. 31, 1927, p. 519.

Patents the incorporation of radium and mesothorium with metals, particularly platinum or gold.

Fischer, Roger, and Wohlers, Henri. (Action of radium emanations on bacteria and their toxins.) Compt. rend. soc. biol., vol. 96, 1927, pp. 507–509.

Radium emanations prevent the development of certain types of bacteria.

Gaschler, A. Increasing radioactivity. U. S. Patent 1644370, 1927.

Process intended to increase the radioactivity of substances.

Grosse, Aristid. The isolation of protoactinium (element 91). Nature (London), vol. 120, 1927, p. 621.

Segregated about 2 milligrams of nearly pure protoactinium and its half life has been determined by Hahn and Walling as 20,000 years. For each gram of radium in a substance there is about 0.4 gram of protoactinium.

Hacquaert, A. L. (Some pseudomorphs of uranium minerals from Katanga.) Natuurwetenschap Tijd., vol. 9, 1927, pp. 34–39. Chem. Abs., vol. 21, 1927, p. 1610.

Cubes of uraninite are replaced by weathering minerals.

Hahn, Otto, and Walling, Ernst. (New determination of the half life of protoactinium; its presence in uranium minerals and by-products.) Naturwissenschaften, vol. 15, 1927, p. 803.

Give half life of protoactinium as 20,760 years within an accuracy of 10 per cent and assume its atomic weight to be 230. A metric ton of uranium in a

mineral would hold 129 and 340 milligrams of radium. Joachimsthal by-products contain 185 milligrams of protoactinium per ton.

Holmes, Arthur. Some problems of physical geology and the earth's thermal history. Geol. Mag., vol. 64, 1927, pp. 263–278.

Discusses the pulsating melting of rocks (due to heat generated by radium) and freezing with consequent changes of rock composition.

Holmes, Arthur, and Lawson, Robert W. Factors involved in the calculation of the ages of radioactive minerals. Am. Jour. Sci., 5th ser., vol. 13, 1927, pp. 327–344.

After consideration of various factors adopt a revised formula for obtaining the age of a mineral from its uraniumthorium and lead ratios. Give a table of ages, but casually reject Davis' determination of uraninite from the Black Hills, though probably one of the most reliable.

Khlopin, V. G. (Radium and its extraction from Russian raw material. Contributions to the study of radium and radioactive ores.) Vol. 1, 1924, pp. 1–176.

A monograph in Russian, treating of the distribution of radium; radioactive minerals; the Russian deposits; chemistry, physics, uses, and technology of radium; details of experiments on, and methods of isolating radium from the Ferghana ores.

Leemans, Joseph. (Some Belgo-Congolese industries.) Chimie et industrie, Spec. No., 1927, pp. 87–100.

Describes Belgian industries based on materials from the Belgian Congo, including the extraction of radium.

Lorah, J. R. Uranium oxide colors and crystals in low-temperature glaze combinations. Jour. Am. Ceram. Soc., vol. 10, 1927, pp. 813–820.

Tints, ranging from yellow to dark orange or red, can be produced by using only U_3O_8 and Pb_3O_4. Ten per cent U_3O_8 will give a deep orange.

Marden, J. W. Uranium, zirconium, tungsten, thorium, or other rare metals. U. S. Patent 1648954, 1927.

A salt of one of the rare metals, such as the double ammonium chloride, is mixed with an excess of some metal, such as aluminum, and heated in a closed vessel to reaction. Other substances are washed from the alloy, and it is treated with HNO_3 or heated to volatilize the alloy from the rare metal.

Markl, J. Pitchblende and pitchblende residues from St. Joachimsthal and their emanation yield. Physikal. Ztschr., vol. 28, 1927, pp. 10–12.

Meyer, Erwin. (The limits of the periodic system of the elements.) Ztschr. Elektrochem. angew. phys. Chem., vol. 33, 1927, pp. 189–192.

Believes that there is almost no chance of the existence of an element with an atomic weight less than that of hydrogen or greater than that of uranium.

O'Neill, John W. Radium emanator adapted for treating water, etc. U. S. Patent 1615912, 1927.

Paneth, Fritz. The use of radio-elements as indicators. Nature (London), vol. 120, 1927, pp. 884–886.

Thinks that the radioactive elements can be used as indicators of extremely small quantities of nearly insoluble materials and for measurement of the surface of powdered absorbents.

Rentschler, H. C., and Marden, J. W. Coherent uranium. U. S. Patent 1648962, 1927.

Uranium powder is pressed and kept in an inert atmosphere such as nitrogen, heated slowly in a high vacuum furnace to expel gases, after which the temperature is raised to a sintering temperature for uranium or higher.

Schoep, Alfred. (Chinkolobwite and sklodowskite.) Ann. soc. geol. Belg., vol. 48, 1926, pp. B303–B306.

Shown to be the same mineral. The name sklodowskite is retained.

———. (Isomorphism of sklodowskite and uranophane.) Natuurwetenschap Tijd., vol. 9, 1927, pp. 30–33.

The two minerals are isomorphous, the calcium of uranophane being replaced by magnesium to form sklodowskite.

Slavik, F. The minerals of Příbram. Am. Miner., vol. 12, 1927, pp. 345–350.

Describes the occurrence of 75 minerals found in the pitchblende veins of Příbram.

Van Aubel, René. (On the genesis of the uraniferous deposits of Kasolo (Katanga).) Compt. rend., vol. 185, 1927, pp. 654–655.

Describes the occurrence of various types of isometric crystals of uraninite in specimens from Katanga.

———. (On the presence of crystallized uraninite in the uraniferous deposits of Kasolo (Katanga).) Compt. rend., vol. 185, 1927, pp. 586–588.

Considers the veins as between pegmatite and the hydrothermal veins; that uraninite was deposited in crystalline form, dissolved by siliceous waters, and redeposited as amorphous pitchblende containing silica.

VANADIUM

GENERAL

Vanadium is one of the rarer metals in the sense that there are few large deposits in which it is sufficiently concentrated to make commercial exploitation profitable, but it is widely distributed through nature and has been reported in very many animate and inanimate substances. The scarcity of large and rich segregations coupled with a somewhat similarly rare segregation of knowledge and technique as applied to the reduction and use of the rarer metals makes the art of handling them a highly specialized branch of the mineral industry in which monopolies or near monopolies are rather easily built up and may, indeed, be almost, if not quite, necessary to the efficient conduct of the business. Probably, however, as in other business, competition is necessary to insure constant alertness and continuous research for greater efficiency in production and use.

Most of the rarer metals have some one outstanding deposit or series of deposits—nickel and Sudbury, molybdenum and Climax, tungsten and Kiangsi, cobalt, radium, uranium and Katanga, and vanadium and Minasragra are almost synonymous.

In the vanadium industry competition is perhaps stiffer than in the others. Although the deposit at Minasragra, Peru, is the richest and largest vanadium deposit known, deposits in South Africa and in the United States are rich enough and large enough and have a metallurgy sufficiently simple to allow them to compete successfully. Not only do vanadium-producing firms compete among themselves, but vanadium must likewise meet the competition of nickel and molybdenum in part of the steel business and also the more careful manufacture of steel, for the properties of many vanadium steels can be duplicated in other steels if sufficient care and time are used in their manufacture. In such steels vanadium may form a cheaper substitute for much of the care and time, but if the cost without vanadium is reduced enough and the quality of the steel is preserved the need for the rarer metal is gone.

Peru is still the largest producer of vanadium, and from that country the United States receives the larger part of its supply. Europe obtains the larger part of its vanadium from the South African vanadates.

United States.—The United States Vanadium Corporation, a subsidiary of the Union Carbide & Carbon Corporation, continued the mining and milling of the vanadium-bearing sandstone on East Rifle Creek, 11 miles north and a little east of Rifle, Colo. The ore carries roscoelite (vanadium mica) and vanoxite (hydrous vanadium oxide) or minerals so near them that they can not be distinguished by ordinary microscopic methods. The difficulties of such studies become more apparent when it is known that the flakes of the mica(?) and the crystals of the vanoxite(?) are in the interstices between sand grains that readily pass through a screen with 100 meshes to the linear inch.

Large improvements were made in the mine and buildings, in the reduction plant, and in the technique of treatment at Rifle. Fused vanadium oxide is made and shipped to the corporation's plants at Columbiana, Ohio, and Niagara Falls, N. Y., for the electric manufacture of ferrovanadium, which carries about 38 per cent vanadium. Some other work has been done on vanadium-bearing sandstone in the vicinity, but the vanadium content is said to have been too low to allow profitable extraction.

The United States Co. of New Jersey did little at its mines and concentrating plant in Dry Valley, between 40 and 50 miles southeast of Moab, Utah. The ore as mined and sorted for the mill averaged about 2.20 per cent V_2O_5, from which concentrates averaging about 8 per cent V_2O_5 were made. The tailings were said to carry 0.40 per cent V_2O_5. The ore carried a small percentage of uranium; but no effort was made to save it, and few if any determinations were made either on ore or concentrates.

Although, as the name implies, water is scarce in Dry Valley, four drilled wells between 400 and 500 feet deep gave 16,000 gallons per day. The concentrates made in 1926 were made into fused vanadium oxide in Denver by W. C. Paterson in 1927.

The company acquired 12 claims on West Elk Creek near New Castle, Colo., from which a car of ore said to have carried 5.40 per cent V_2O_5 and only a fractional per cent of U_3O_8 was shipped to Denver. The deposit is thought to be in the same geological horizon and to be similar to the deposit of the United States Vanadium Corporation, a short distance west. The company also acquired the Calamity, Maverick, Outlaw, and Flat Top groups of claims, formerly held by the Radium Corporation of Colorado, in the Gateway district of Colorado, and two groups of claims in Long Park, 56 miles west of Placerville. At the close of the year the company had in contemplation another mill conveniently accessible to its newly obtained properties.

Experiments were conducted at Goodsprings, Nev., on the concentration of descloizite and related minerals by centrifugal concentration, but without definite success.

No large deposits of lead, zinc, or copper vanadates have yet been developed in the United States.

Mexico.—The vanadinite deposits at Ahumada, Chihuahua, seem not to have developed as expected, and only a comparatively small quantity was shipped to the Vanadium Corporation of America at Bridgeville, Pa., which had agreed to smelt the ore.

Peru.—According to Government statistics, shipments of vanadium ores from Peru during 1927 contained 660,769 kilos (1,456,745 pounds) of elemental vanadium, against 857,020 kilos (1,889,403 pounds) in 1926. Presumably the vanadium was in material averaging about 11.75 per cent vanadium or, roundly, 6,200 short tons and 8,000 short tons, respectively. About 1 per cent of the output is said to be contained in the ash of asphaltite from Llasacocha and the remainder from Minasragra. The ash is shipped to France. As is well known, the ore minerals at Minasragra are patronite, a sulphide, and its oxidation products.

Northern Rhodesia.—Note was made in this chapter for last year of the plans of the Rhodesia Broken Hill Development Co. (Ltd.) to erect an electrolytic zinc plant at Broken Hill and at the same time erect a plant for the production of ferrovanadium, which the company expects to put out at an annual rate of 315 to 650 tons carrying 34 per cent vanadium, the quantity to depend on the type of ore treated. The plant was said to be well along toward completion at the end of the year.

Analyses of carload lots of Broken Hill (northern Rhodesia) vanadium concentrates imported into the United States during the last two or three years have shown the following range in contents:

Range of analyses of vanadium ores from Broken Hill, Rhodesia

	Per cent		Per cent
Vanadium (V)	11.07–11.37	Zinc (Zn)	14.12–15.00
Lead (Pb)	46.23–47.80	Arsenic (As)	.55– .65
Copper (Cu)	.75– .89	Phosphorus (P)	.048– .055

The Northern Rhodesia Base Metals Co. was reported to have found rich vanadium ore on its property and to have exported concentrates during the year.[58]

According to the Rhodesia Chamber of Mines (Bulawayo) Annual Report a total of 216 long tons (242 short tons), valued at £60,734, was produced in 1927.

Southwest Africa Territory.—The vanadium mines in the vicinity of Otavi and Tsumeb were described in the South African Mining and Engineering Journal of September 10 and 17, 1927, in a series of unsigned articles on "Minerals and Mines in Southwest Africa." According to the writer, at least three of the deposits, those at Abenab, Bobas, and Uitsab, are large pipelike bodies in a very heavily bedded dolomite said to be 10,000 feet thick. The Abenab mine of the South-West Africa Co. is about 25 miles (30 by road) east of Tsumeb and is well and modernly equipped. The roughly oval pipe has an area of approximately 100 by 200 meters (325 by 650 feet) and is filled with a breccia of dolomite in which are calcite, descloizite (lead-zinc vanadate), and less vanadinite (lead chlor-vanadate). Outside the pipe a three-compartment shaft has been sunk 180 feet to a point 10 feet above water level, to which a winze has been sunk. There are five levels, the first of which connects with an open cut 50 feet deep.

Three thousand tons of ore is handled monthly, giving 100 to 110 tons of concentrates, of which a typical analysis is said to be:

Typical analysis of concentrate from the Abenab mine near Tsumeb, Southwest Africa

	Per cent		Per cent
Vanadium (V) (V_2O_5, 20.13)	11.47	Zinc (Zn)	3.81
Lead (Pb)	47.82	Phosphorus pentoxide (P_2O_5)	.04
Copper (Cu), less than	1.00		

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[58] South African Mining and Engineering Journal: Progress in Northern Rhodesia, vol. 38, p. 169, Johannesburg, 1927.

It will be noted that no determination of arsenic is given. In the company's report for the year ended June 30, 1927,[59] it is said:

> What is of great importance, and what principally affects our profit and loss account, is the production and sale of vanadium ore. We have equipped our Abenab property on a large scale, so that we should be in a position to meet any reasonable demand which may arise. With the property thus equipped and with the necessary labor available it is better policy to continue production and to increase our stock rather than to reduce output with consequent increased production cost and to be obliged to dispense with part of the native labor, which we should have very great difficulty in recovering when the necessity arose.

The Abenab production for the year ended June 30, 1927, was 1,298 tons of high-grade vanadium concentrates. Shipments amounted to 981 tons (presumably long tons).

At Bobas, 14 miles west of Tsumeb, the Otavi Exploring Syndicate (Ltd.), a subsidiary of the South-West Africa Co., works another pipelike body that contains practically no dolomite in the breccia, but much more calcite, and descloizite is the only vanadium mineral. This mine also has an open cut to the first level. Most of the ore is above the 62-meter level, but the ore body in an attenuated form has been followed to the 72-meter level. Working one shift of nine hours the plant has a monthly capacity of about 1,050 tons of ore.

The Uitsab deposit, also owned by the South-West Africa Co., is 20 miles west of Grootfontein and is a pipelike body without breccia. It is smaller but apparently richer than the Abenab or Bobas deposits. It has been prospected only.

At Tsumeb the Otavi Minen und Eisenbahn Gesellschaft operates a mine which is described as a "geological museum." A certain quantity of hand-picked descloizite was being produced during the year which averaged more than 18 per cent V_2O_5, and was being shipped to Germany.

Besides vanadium the mine carries lead, copper, silver, zinc, cadmium, germanium, gallium, and arsenic. The deposit contains the only known large and rich deposit of germanium. Hundreds of tons of germanite, a germanium-bearing tetrahedrite, have been found. Germanite is one of some two dozen new minerals said to have been described from this mine.

Fourteen miles east of Grootfontein, at Bergaukas, a considerable quantity of vanadium concentrates has been obtained by hand methods from alluvial deposits found in "potholes" in the dolomite.

The South-West Africa Co., with local headquarters at Grootfontein, owns a concession covering 1,000 square miles and thus controls a large part of the known vanadium and other ore deposits of the region, among which are said to be many undeveloped vanadium deposits. Sir Edmond Davis apparently controls the Rhodesia Broken Hill Development Co. (Ltd.), the South-West Africa Co., and the Otavi Railroad.

Analyses of car lots of Southwest Africa vanadium ores imported into the United States in various years since 1921 have ranged as follows:

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[59] South African Mining and Engineering Journal, Dec. 31, 1927, pp. 479-480.

Analyses of car lots of vanadium ores from Southwest Africa, in per cent

	Better grade	Lower grade
Vanadium (V)	10.56 –10.69	7.19 – 9.38
Lead (Pb)	45.01 –45.34	30.85 –40.59
Copper (Cu)	9.33 – 9.51	6.49 – 8.42
Zinc (Zn)	3.16 – 4.96	3.06 – 4.29
Iron (Fe)	2.23 – 3.64 Fe_2O_3	.86 – 1.10
Phosphorus (P)	.050– .074	.038– .068
Silica (SiO_2)	4.08	4.12 – 7.80
Alumina (Al_2O_3)	1.52	.56 – .74
Lime (CaO)	.84	11.83 –14.40
Magnesia (MgO)	1.58	.88 – 1.23
Arsenic (As)	1.26	.76 – .99

The last five determinations of the better-grade ore were made on a composite sample of seven carloads.

Production of vanadium ore from Southwest Africa Territory during 1927 was 3,038 long tons (3,403 short tons) carrying 18 per cent V_2O_5 (10.08 per cent V) valued at £158,000.

RESOURCES

United States.—What the estimates of vanadium resources are depends, of course, on price and on who makes the estimate, for in making an estimate it must be frankly admitted that little exact data on measurements of ore bodies are at hand and opinions on the individual deposits differ greatly. The ore body north of Rifle, Colo., was examined by responsible engineers who believed it could not be made to pay a profit at present prices. A company leased it, made it pay, and a third company after a careful examination of ore body and process bought the lease and the property. Other properties, formerly worked for radium, are pronounced nonpayable at present prices, yet men with experience have bought large groups of claims. On these bases, recognized as not very sound, it may tentatively be estimated that under present processes and at present prices possibly 5,500,000 pounds (2,750 tons) of vanadium in the form of ferrovanadium can be produced, that possibly 8,000,000 pounds could be produced at $5 per pound, and at $10 most of the carnotite beds of Colorado, Utah, Arizona, and New Mexico would be exploitable. The roscoelite beds at Placerville, Colo., would also be included at such a price, and a total of at least 100,000,000 pounds of vanadium would probably be available. Before $10 a pound was reached some millions of pounds of vanadium would undoubtedly become available from ilmenite-magnetite mixtures, of which the United States has many millions of tons that carry from 0.1 to 0.3 per cent, and the phosphate deposits of Idaho, Montana, Utah, and Wyoming would also be made to yield large quantities of vanadium from the 0.1 to 0.2 per cent which they carry.

Peru.—Peru may produce at its present rate for 25 years at present prices, so that the reserve can probably be estimated as at least 36,000,000 pounds (18,000 tons). At $5 or $6 a pound very large quantities of vanadium would probably become available from a carbonaceous shale which has been estimated to carry from 0.1 to 1 per cent of vanadium.

Africa.—The resources of Broken Hill, Northern Rhodesia, have been estimated[60] as 2,089 tons of metal. What the resources of

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[60] See report of this series for 1926.

Southwest Africa may be is problematical, but 2,500 tons of elemental vanadium, at present prices, seems well under the mark.

Total.—From known world resources at present prices it seems probable that more than 25,000 tons of elemental vanadium can be produced.

TECHNOLOGY

Production from ilmenite.—Efforts to isolate the vanadium which generally accompanies ilmenite-magnetite mixtures continue. B. P. F. Kjellberg[61] has worked with such ores from which most of the vanadium could be separated magnetically with the magnetite. Although the concentrate contained a little more titanium than the heads the iron was almost trebled and the vanadium was quadrupled—raised from 0.185 to 0.78 per cent. He supposes the vanadium to be present as $FeO.V_2O_3$, which in ore ground to 200 mesh is made soluble by roasting and oxidation at about 1,000° C., and the magnetite (Fe_3O_4) is oxidized to Fe_2O_3. The vanadium is thus made 60 per cent soluble in sulphurous acid. If fluorspar is added before roasting, 80 per cent of the vanadium is made soluble.

With an annual production at Kramsta of 16,000 tons of concentrate the total cost is $8 per ton. The iron ore is also improved by the removal of phosphorus and sulphur. Rutger von Seth, whose process of getting into the slags the vanadium from such ores was noted in the chapter of this series for 1925, has described with Gunnar Hult trials of the process in a small 4-ton converter. The weight of slag was 2.5 to 3 per cent of the pig iron and contained 8.50 to 11.30 per cent of V_2O_5.[62]

Pure vanadium.—Marden and Rich have described a process for isolating pure vanadium,[63] a feat that has very seldom been accomplished. The pentoxide (V_2O_5) was mixed with calcium and calcium chloride and placed in a bomb. On top of the charge was placed a little potassium or sodium. The bomb was then closed and heated to 900 or 950°. The metal was obtained in pellets averaging 99.8 per cent V. They were steel white and malleable, and if put in an iron tube could be rolled into rod or wire. They could be melted in vacuo.

Driers.—Swehten has described the manufacture and use of vanadium in driers for paints.[64] Vanadium resinate is slightly less efficient than cobalt compounds but hardens linseed oil two and five-tenths times as fast as manganese and five times as fast as lead. It can not be used for white paints, as it forms brownish films.

Catalysts.—Perhaps the most promising of the newer uses for vanadium is that of the pentoxide and other compounds as catalysts. Large surphuric acid plants are said to be replacing platinum by this material, and it has been prophesied that it will eventually entirely replace the precious metal. It is also being used as a catalyst in many organic reactions. One company is now supplying about 2 tons of fused oxide per month for catalytic use. Nickell[65] reviews the attempts to use vanadium compounds as catalysts since first publicly proposed by Johann J. Walter in 1895, and numerous patents issued in the interval. Nickell finds catalysts consisting essentially of complex vanadium silicates to give efficiencies of 97 to 98 per cent, with none of the poisoning of the catalyst by arsenic or hydrochloric acid, such as affects platinum. He freely predicts "that within the next decade the use of platinum catalysts for sulphuric acid will be entirely abandoned and the use of vanadium catalysts completely established in their stead." Others use other very finely divided salts precipitated on silica gel or other substances.

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[61] Kjellberg, B. P. F., Recovering the Vanadium in Titaniferous Iron Ores: Eng. and Min. Jour., vol. 123, 1927, pp. 521–522.

[62] von Seth, Rutger, and Hult, Gunnar, von Seth's Method of Extracting Vanadium from Pig Iron: Tek. Tid. Uppl. C. (Bergsvetenskap), vol. 57, 1927, pp. 20–22.

[63] Marden, J. W., and Rich, M. N., Vanadium: Ind. and Eng. Chem., vol. 19, 1927, pp. 786–788, 2 pho. reps.

[64] Swehten, R., Vanadium Compounds Used for the Manufacture of Siccatives: Farben-Ztschr., vol. 32, 1927, pp. 1138–1139.

[65] Nickell, L. F., New Vanadium Catalyst for Sulphuric Acid: Chem. and Met Eng., vol. 35, March, 1928, p. 153.

WORLD PRODUCTION

The world production of vanadium contained in ore or concentrates in 1926 and 1927 was apparently as follows:

World production of vanadium in ores and concentrates, 1926 and 1927

Country	1926		1927	
	Pounds	Value	Pounds	Value
United States	661,360	$314,000	(1)	(1)
Peru	1,889,403	[2] 944,701	1,456,745	[2] $728,373
Northern Rhodesia	42,203	[2] 21,101	53,222	[2] 26,611
Southwest Africa Territory	1,268,951	[2] 634,475	685,956	[2] 342,978
Mexico	----------	----------	2,950	[2] 1,475

[1] Bureau of Mines not at liberty to publish figures.
[2] Value arbitrarily fixed at 50 cents a pound for vanadium contained.

IMPORTS AND EXPORTS

The imports of vanadium ores into the United States are shown by the following tables:

Vanadium ore (steel hardening) imported for consumption in the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918, July to December [1]	1,772,215	$5,333	1923	4,177,115	$229,210
1919	6,026,005	67,846	1924	14,116,596	722,731
1920	20,673,296	1,080,935	1925	4,735,461	339,468
1921	10,307,540	543,061	1926	16,735,040	914,114
1922	611,170	86,776	1927	13,885,760	561,051

[1] Not separately classified prior to July, 1918.

Vanadium ores produced in and imported into the United States, 1926 and 1927

	1926			1927		
	Ore		Value	Ore		Value
	Pounds	Estimated vanadium content (pounds)		Pounds	Estimated vanadium content (pounds)	
Production	43,200,000	661,360	$314,000	(1)	(1)	(1)
Imports:						
Europe [2]	1,099,840	104,500	46,607	----------	----------	----------
British South Africa	47,040	4,470	3,956	2,240	224	$121
Peru	15,588,160	1,831,600	863,551	13,883,520	1,631,313	560,930
	59,935,040	2,601,930	1,228,114	(1)	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures of production.
[2] Recorded as from France for 1926; probably was from southern Africa.

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FRENCH, H. J. A comparison of the alloying elements chromium, nickel, molybdenum, and vanadium in structural steels. Trans. Am. Soc. Steel Treating, vol. 11, pp. 845–888, 1927.

JORDAN, LOUIS, and QUICK, G. W. Alloy. U. S. Patent 1638855, 1927.

Vanadium steel suitable for the preparation of balls for use in measuring Brinell hardness contains 10 to 15 per cent vanadium and 2 to 4 per cent carbon.

——— ——— Iron-carbon-vanadium alloy for Brinell balls. Trans. Am. Soc. Steel Treating, vol. 12, pp. 3–24, 1927.

NEWMAN, W. A., and PASCOE, C. F. Making locomotives stronger. Iron Age, vol. 119, pp. 701–704, 1927.

Nickel steels were found to be in some ways better than vanadium steels.

SCHERER, R. (Influence of cobalt, vanadium, and manganese on the properties of tool steels.) Arch. Eisenhüttenw., vol. 1, pp. 325–329, 1927; Stahl u. Eisen, vol. 47, pp. 2035–2036, Düsseldorf, 1927.

Finds that eutectoidal tool steels with 0.9 per cent C, 2.28 per cent Co, and 0.43 per cent V give excellent results.

SCHREITER, R. Vanadiumoxyde in sächsischen Rotliegenden und ihre Bleichungwirkung. Jahrb. Berg- und Hüttenw. in Sachsen, Freiberg, vol. 101, 1927, pp. A49–A69.

SOMEYEA, KIN'ICHI. See tungsten bibliography, p. 440.

South African Mining and Engineering Journal. Vanadium: A useful and valuable element. Its ores, occurrences and uses. Vol. 38, p. 265, Johannesburg, 1927.

A general article.

THEWS, K. B. Vanadium from solutions. U. S. Patent 1621038, 1927.

Calcium vanadate is precipitated from a solution of vanadium contaminated with iron and aluminium, by the addition of a suitable lime compound, such as $CaCl_2$, while the solution is kept nonalkaline.

ZAMBONINI, F. A chemical study of the yellow incrustations of the Vesuvian lava of 1631. Translated by Henry S. Washington. American Mineralogist, vol. 12, 1927, pp. 1–10.

Finds that a yellow crust on the Vesuvian lava of 1631 contained a vanaidum mineral which he identified on very small quantities of impure material as a hydrous descloizite which he calls vesbine and assigns to it the formula $(Pb, Cu)_3V_2O_5.(Pb, Cu)(OH)_2.5H_2O$. which may be more simply written $4(Pb, Cu)O.V_2O_5.6H_2O$.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

The total calculated gross value of the recoverable gold, silver, copper, lead, and zinc from ore and gravel produced in New Mexico in 1927 amounted to $15,662,076, compared with $14,481,808 in 1926—an increase of 8 per cent. There were 112 producing mines in 1927, of which 102 were lode and 10 were placers, a decrease of 14 lode mines and 2 placer mines from 1926.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver prices for 1904 to 1915 are from the report of the Director of the Mint and represent the equivalent value per fine ounce based on average price and average rate of exchange; for 1916 and 1917, dealers' buying price, New York; for 1918, early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper prices for 1904 to 1915 are those at New York; for 1916 and later years, weighted average price, for each year, of all grades of primary metal sold by producers. The lead prices for 1904 to 1915 are those at New York; for 1916, outside spot quotations, New York; for 1917 and later years, weighted average price, for each year, of all grades of primary metal sold by producers. The zinc prices for 1904 to 1914 are those at St. Louis; for 1915 and later years, weighted average price, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1904–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1904	$0.58	$0.128	$0.043	$0.051	1916	$0.658	$0.246	$0.069	$0.134
1905	.61	.156	.047	.059	1917	.824	.273	.086	.102
1906	.68	.193	.057	.061	1918	1.00	.247	.071	.091
1907	.66	.20	.053	.059	1919	1.12	.186	.053	.073
1908	.53	.132	.042	.047	1920	1.09	.184	.08	.081
1909	.52	.13	.043	.054	1921	1.00	.129	.045	.05
1910	.54	.127	.044	.054	1922	1.00	.135	.055	.057
1911	.53	.125	.045	.057	1923	.82	.147	.07	.068
1912	.615	.165	.045	.069	1924	.67	.131	.08	.065
1913	.604	.155	.044	.056	1925	.694	.142	.087	.076
1914	.553	.133	.039	.051	1926	.624	.14	.08	.075
1915	.507	.175	.047	.124	1927	.567	.131	.063	.064

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1904–1927, in terms of recovered metals

Year	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
1904	80	24	104	102, 339	18, 476. 00	$381, 930	214, 553	[1] $124, 441
1905	52	21	73	145, 629	15, 359. 56	317, 510	369, 192	[1] 225, 207
1906	52	19	71	207, 691	14, 174. 80	293, 019	491, 127	[1] 333, 966
1907	104	23	127	219, 992	15, 962. 88	329, 982	705, 544	465, 659
1908	108	26	134	135, 434	14, 452. 37	298, 757	405, 044	214, 673
1909	111	17	128	164, 156	11, 585. 38	239, 491	397, 783	206, 847
1910	85	23	108	191, 865	23, 337. 26	482, 424	843, 987	455, 753
1911	85	20	105	232, 699	36, 900. 84	762, 808	1, 354, 540	717, 906
1912	119	26	145	1, 352, 286	37, 947. 57	784, 446	1, 536, 701	945, 071
1913	108	20	128	2, 217, 660	42, 663. 17	881, 926	1, 631, 273	985, 289
1914	115	24	139	2, 232, 853	56, 680. 79	1, 171, 696	1, 777, 445	982, 927
1915	148	26	174	2, 797, 072	70, 680. 96	1, 461, 105	2, 005, 531	1, 016, 804
1916	191	19	210	3, 870, 950	66, 877. 47	1, 382, 480	1, 766, 274	1, 162, 208
1917	177	15	192	4, 576, 827	51, 478. 64	1, 064, 158	1, 394, 365	1, 148, 957
1918	119	9	128	4, 749, 784	33, 030. 02	682, 791	782, 421	782, 421
1919	86	6	92	2, 155, 998	31, 717. 36	655, 656	837, 418	937, 908
1920	93	6	99	2, 250, 718	23, 234. 61	480, 302	768, 042	837, 166
1921	40	9	49	611, 576	9, 521. 26	196, 822	571, 899	571, 899
1922	74	17	91	1, 576, 920	19, 964. 02	412, 693	752, 240	752, 240
1923	104	16	120	3, 111, 050	26, 689. 12	551, 713	747, 127	612, 644
1924	86	10	96	3, 040, 652	24, 803. 56	512, 735	795, 070	532, 697
1925	92	12	104	3, 358, 566	26, 561. 40	549, 073	735, 124	510, 176
1926	116	12	128	3, 825, 894	19, 630. 72	405, 803	450, 934	281, 383
1927	102	10	112	3, 442, 184	29, 241. 87	604, 483	890, 083	504, 677
Total, 1904–1927				46, 570, 795	720, 971. 63	14, 903, 803	22, 223, 717	15, 308, 919

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1904	4, 972, 170	[1] $636, 438	3, 122, 872	$134, 283	13, 493, 835	[1] $688, 186	[1] $1, 965, 278
1905	6, 126, 025	955, 660	1, 510, 209	70, 980	15, 142, 254	893, 393	[1] 2, 462, 750
1906	7, 028, 670	1, 356, 533	2, 987, 369	170, 280	17, 292, 655	1, 054, 852	[1] 3, 208, 650
1907	10, 990, 015	2, 198, 003	3, 809, 881	201, 924	750, 085	44, 255	3, 239, 823
1908	6, 112, 630	806, 867	873, 763	36, 698	3, 576, 516	168, 096	1, 525, 091
1909	5, 393, 146	701, 109	5, 029, 767	216, 280	13, 085, 945	706, 641	2, 070, 368
1910	4, 614, 386	586, 027	4, 320, 841	190, 117	18, 088, 129	976, 759	2, 691, 080
1911	4, 057, 040	507, 130	2, 966, 222	133, 480	10, 237, 176	583, 519	2, 704, 843
1912	34, 030, 964	5, 615, 109	5, 494, 018	247, 231	13, 566, 637	936, 098	8, 527, 955
1913	56, 308, 706	8, 727, 850	3, 946, 364	173, 640	16, 523, 161	925, 297	11, 694, 002
1914	59, 307, 925	7, 887, 954	1, 763, 641	68, 782	18, 403, 392	938, 573	11, 049, 932
1915	76, 788, 366	13, 437, 964	4, 542, 361	213, 491	25, 404, 064	3, 150, 104	19, 279, 468
1916	92, 747, 289	22, 815, 833	8, 214, 189	566, 779	36, 570, 649	4, 900, 467	30, 827, 767
1917	105, 568, 000	28, 820, 064	9, 108, 804	783, 357	30, 200, 000	3, 080, 400	34, 896, 936
1918	98, 264, 563	24, 271, 347	8, 398, 239	596, 275	24, 050, 324	2, 188, 579	28, 521, 413
1919	51, 150, 541	9, 514, 000	2, 886, 513	152, 985	7, 594, 644	554, 409	11, 814, 958
1920	54, 400, 691	10, 009, 727	2, 869, 525	229, 562	10, 013, 580	811, 100	12, 367, 857
1921	14, 267, 338	1, 840, 487	678, 601	30, 537	228, 000	11, 400	2, 651, 145
1922	31, 937, 207	4, 311, 523	3, 012, 223	165, 672	4, 496, 806	256, 318	5, 898, 446
1923	61, 356, 802	9, 019, 450	3, 832, 427	268, 270	16, 496, 000	1, 121, 728	11, 573, 805
1924	74, 691, 436	9, 784, 578	3, 634, 511	290, 761	20, 759, 200	1, 349, 348	12, 470, 119
1925	76, 427, 825	10, 852, 751	6, 420, 060	558, 545	18, 492, 300	1, 405, 415	13, 875, 960
1926	81, 642, 379	11, 429, 933	6, 960, 366	556, 829	24, 104, 800	1, 807, 860	14, 481, 808
1927	74, 251, 863	9, 726, 994	16, 052, 855	1, 011, 330	59, 603, 000	3, 814, 592	15, 662, 076
Total, 1904–1927	1, 092, 435, 977	195, 813, 331	112, 435, 621	7, 068, 088	418, 173, 152	32, 367, 389	265, 461, 530

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[1] Revised figures.

Gold and silver produced at placer mines in New Mexico, 1904–1927

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1904	7,228.39	$149,424			$149,424
1905	4,805.34	99,335	662	$404	99,739
1906	1,296.81	26,807	195	133	26,940
1907	935.56	19,340	173	114	19,454
1908	1,122.20	23,198	153	81	23,279
1909	1,064.73	22,010	162	84	22,094
1910	1,262.30	26,094	374	202	26,296
1911	905.29	18,714	162	86	18,800
1912	818.79	16,926	140	86	17,012
1913	380.27	7,861	90	54	7,915
1914	1,410.22	29,152	330	182	29,334
1915	447.09	9,242	55	28	9,270
1916	537.74	11,116	72	47	11,163
1917	589.16	12,179	92	76	12,255
1918	150.83	3,118	21	21	3,139
1919	239.89	4,959	33	37	4,996
1920	105.84	2,188	20	22	2,210
1921	400.59	8,281	61	61	8,342
1922	190.21	3,932	39	39	3,971
1923	204.05	4,218	30	24	4,242
1924	176.04	3,639	27	18	3,657
1925	97.62	2,018	13	9	2,027
1926	129.98	2,687	45	28	2,715
1927	280.97	5,808	32	18	5,826
Total, 1904–1927	24,779.91	512,246	2,981	1,854	514,100

GOLD

The mine production of recoverable gold in New Mexico in 1927 amounted to 29,241.87 fine ounces, valued at $604,483, compared with 19,630.72 fine ounces, valued at $405,803, in 1926. San Miguel County produced 39 per cent of the total in 1927, Hidalgo 32.7 per cent, Grant 17.7 per cent, Colfax 5.8 per cent, Santa Fe 2.4 per cent, and Sierra 1.4 per cent. Copper ore yielded 49.4 per cent of the total, lead-zinc ore 40.6 per cent, and dry and siliceous ore 8.6 per cent. Placer mines yielded 1 per cent.

SILVER

The mine production of recoverable silver in New Mexico in 1927 amounted to 890,083 fine ounces, valued at $504,677, compared with 450,934 fine ounces, valued at $281,383, in 1926. San Miguel County produced 57.2 per cent of the total, all from the lead-zinc ore from the Pecos mine, in the Willow Creek district; Grant County 16.1 per cent, chiefly from the Central district; Hidalgo County 10.4 per cent, chiefly from the copper ore of the Lordsburg district; Socorro County 7.9 per cent, all from the Magdalena district; Santa Fe County 6.2 per cent, chiefly from the lead-zinc ore of the San Pedro (New Placers) district; and Sierra County 1.2 per cent, chiefly from the Chloride district. Placer mines yielded 32 ounces of silver.

Lead-zinc ore yielded 71.6 per cent of the total, from San Miguel, Santa Fe, Grant, and Socorro Counties; copper ore yielded 13.7 per cent, chiefly from Hidalgo and Grant Counties; dry and siliceous ore yielded 6.9 per cent, chiefly from Socorro and Hidalgo Counties; and lead ore yielded 6.1 per cent, chiefly from the Central district, Grant County.

COPPER

The mine production of recoverable copper in New Mexico in 1927 amounted to 74,251,863 pounds, valued at $9,726,994, compared with 81,642,379 pounds, valued at $11,429,933, in 1926. Of the total in 1927, 96 per cent was produced in Grant and Hidalgo Counties, chiefly from the operations of the Santa Rita mines, in the Central district, and from the Eighty-Five mine, in the Lordsburg district. San Miguel County, third in order of output, yielded 2.7 per cent. Copper ore yielded 96.3 per cent of the total and lead-zinc ore 2.8 per cent.

LEAD

The mine production of recoverable lead in New Mexico in 1927 amounted to 16,052,855 pounds, valued at $1,011,330, compared with 6,960,366 pounds, valued at $556,829, in 1926. The chief lead-producing districts were the Willow Creek district, San Miguel County; the San Pedro (New Placers) district, Santa Fe County; the Central district, Grant County; and the Magdalena district, Socorro County. Lead-zinc ore yielded 74.6 per cent of the total and lead ore 17 per cent.

ZINC

The mine production of recoverable zinc in New Mexico in 1927 amounted to 59,603,000 pounds, valued at $3,814,592. The chief zinc-producing districts were the Willow Creek, in San Miguel County; the Central (Hanover), in Grant County; the Magdalena (Kelly), in Socorro County; and the San Pedro (New Placers), in Santa Fe County.

Zinc and lead-zinc concentrates produced in 1927 amounted to 70,961 tons, containing as shipped 4,469.27 ounces of gold, 234,949 ounces of silver, 1,519,623 pounds of copper, 1,999,319 pounds of lead, and 72,317,104 pounds of zinc. The average content in zinc was therefore 50.96 per cent.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1927, by counties, in terms of recovered metals

County	Mines producing			Ore (short tons)	Gold (lode and placer)	Silver (lode and placer)	
	Lode	Placer	Total			Fine ounces	Value
Catron	1	--------	1	89	$4, 678	3, 591	$2, 036
Colfax	1	5	6	6, 328	35, 117	353	200
Dona Ana	4	--------	4	218	77	1, 862	1, 056
Eddy	1	--------	1	30	--------	--------	--------
Grant	33	4	37	3, 103, 250	107, 076	143, 434	81, 327
Guadalupe	1	--------	1	6, 953	--------	--------	--------
Hidalgo	21	--------	21	98, 940	197, 401	92, 896	52, 672
Lincoln	2	--------	2	60	--------	381	216
Luna	5	--------	5	1, 125	325	2, 058	1, 167
Otero	2	--------	2	701	396	127	72
San Miguel	1	--------	1	164, 874	235, 766	509, 446	288, 856
Santa Fe	5	1	6	16, 892	14, 251	55, 157	31, 274
Sierra	14	--------	14	1, 022	8, 621	10, 300	5, 840
Socorro	11	--------	11	41, 702	775	70, 478	39, 961
	102	10	112	3, 442, 184	604, 483	890, 083	504, 677
Total, 1926	116	12	128	3, 825, 894	405, 803	450, 934	281, 383

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1927, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron							$6, 714
Colfax	1, 687	$221					35, 538
Dona Ana	1, 923	252	71, 651	$4, 514			5, 899
Eddy	2, 390	313					313
Grant	67, 237, 878	8, 808, 162	2, 774, 364	174, 785	10, 270, 000	$657, 280	9, 828, 630
Guadalupe	611, 893	80, 158					80, 158
Hidalgo	4, 078, 588	534, 295	232, 159	14, 626			798, 994
Lincoln	3, 382	443	21, 683	1, 366			2, 025
Luna	367	48	206, 080	12, 983			14, 523
Otero	11, 923	1, 562	72, 126	4, 544			6, 574
San Miguel	1, 989, 000	260, 559	8, 706, 000	548, 478	42, 445, 000	2, 716, 480	4, 050, 139
Santa Fe	118, 519	15, 526	2, 208, 125	139, 112	2, 446, 000	156, 544	356, 707
Sierra	20, 496	2, 685	123, 000	7, 749	12, 000	768	25, 663
Socorro	173, 817	22, 770	1, 637, 667	103, 173	4, 430, 000	283, 520	450, 199
	74, 251, 863	9, 726, 994	16, 052, 855	1, 011, 330	59, 603, 000	3, 814, 592	15, 662, 076
Total, 1926	81, 642, 379	11, 429, 933	6, 960, 366	556, 829	24, 104, 800	1, 807, 860	14, 481, 808

MINING INDUSTRY

The outstanding feature of metal production in New Mexico in 1927 was the entrance of the American Metal Co.'s Pecos mine at the junction of Willow Creek and Pecos River, San Miguel County, into the producing list. The recoverable content of the selective flotation mill products from the ore of the Pecos mine made it the largest single producer of gold, silver, lead, and zinc in the State and the second largest producer in the State in terms of calculated gross value of recoverable metals. The production of this mine and other zinc-producing mines in New Mexico gave the State a recoverable zinc production in 1927 of 59,603,000 pounds, as compared with 160,462,000 pounds in Montana, 99,185,000 pounds in Utah, and 71,729,000 pounds in Colorado.

The largest mine in point of tonnage and recoverable gross value was the Chino Mines (of the Nevada Consolidated Copper Co.) at Santa Rita, one of the large porphyry low-grade copper mines of the United States. This mine held its production in 1927 under that of 1926, the tonnage treated at its flotation mill at Hurley being 2,982,137 dry tons in 1927 as against 3,523,319 dry tons in 1926, or in tons per day 8,170 tons in 1927 and 9,653 in 1926. The cost of milling, exclusive of depreciation and taxes but including all other expenses, was 70.2 cents per ton in 1927 and 62.6 cents per ton in 1926. The mining cost for the year, exclusive of depreciation and taxes but including all other expenses of every nature, was 34.8 cents per ton in 1927 and 36.4 cents in 1926; stripping cost 48.54 cents per cubic yard in 1927 and 51.44 cents in 1926. The usual charge against each ton of ore produced to cover prepaid development or stripping expense or both was 45 cents per ton for each year. The published combined report of the Nevada, Ray, and Chino divisions of the Nevada Consolidated Copper Co. gives no record of the grade of ore treated by each division for either 1927 or 1926. The Chino Mines 1927 production requirements were wholly supplied from shovel operations, which will continue to produce the total ore requirements at this division for the next two years, but the opening of the Estrella ore body for underground mining will be continued, and the necessary shafts, surface facilities, and underground haulage ways will be driven in the meantime, so as to be prepared for production from underground sources well in advance of requirements.

The third largest producing mine in New Mexico in 1927 was the Eighty-Five branch of the Calumet & Arizona Copper Co. at Lordsburg, Hidalgo County. This mine produced approximately its usual tonnage of highly siliceous copper-gold-silver ore for use at the Calumet & Arizona copper smelter at Douglas, Ariz.

The Mogollon silver-gold district remained idle. Prior to 1926 it was a very important contributor to the silver and gold production of the State, as is shown in the production table for the district on page 465. The Magdalena district continued milling zinc ores until August, 1927; there was other production also. The Burro Mountain, or Tyrone district, continued small leaching operations and mine development. Realization on the relatively large development expenditures at the Burro Mountain branch of the Phelps Dodge Corporation seems destined to await improvement in metallurgical practice. The Central mining district, including Hanover, Fierro, Santa Rita, Vanadium, and Georgetown, continued to be the principal mining district in point of value of metals produced and in variety of metals, and the largest producer was the Chino Mines. The Empire Zinc Co. at Hanover continued to produce zinc concentrate, but in 1927 the product was made in the company's new flotation mill, by treating zinc tailings from the magnetic separation mill. The Hanover-Bessemer Iron & Copper Co. continued to ship magnetite ore and copper oxidized ores won as by-product of magnetite mining. The Lucky Bill mine at Hanover and the Ground Hog at Vanadium shipped copper-lead-silver mixed oxidized and sulphide smelting ore. The Peru Mining Co. (subsidiary of the Illinois Zinc Co.) purchased the property of the Hanover Copper Co. and that of the Grant County Copper Co. and started development work at the mine and the construction of a flotation mill at Deming. East of Santa Rita, in the Swartz district, the Royal John lead-zinc mill was remodeled. The operations in the Pinos Altos district were intermittent. In the Gold Hill district the one-man operation at Gold Hill resulted in a few shipments of gold bullion. Sierra County production fell off, owing to the abandonment of operations at the old Lake Valley mine dump. Operations in the Cooks Peak, Florida Mountains, Tres Hermanas, and Victorio districts, Luna County, were small. There was a small renewal of operations at Organ, Dona Ana County; at Orogrande and in the Sacramento Mountains east of Alamogordo, Otero County; and in the Gallinas Mountains, Lincoln County. The Aztec gold mine, on Mount Baldy, in Colfax County, was again in operation. Production of copper ore from the "Red Beds" near Pastura, Guadalupe County, was of interest, as was the shipment of copper ore from the limestone beds, west of Carlsbad, Eddy County.

Gold and silver produced at placer mines in New Mexico in 1927, by counties, in fine ounces

County	Hydraulic		Sluicing		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Colfax	46.41	8	57.85	8	104.26	16
Grant	----------	----------	33.52	9	33.52	9
Santa Fe	----------	----------	143.19	7	143.19	7
	46.41	8	234.56	24	280.97	32

ORE CLASSIFICATION

Ore sold or treated in New Mexico in 1927, with content in terms of recovered metals

Source	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	8,984	2,232.41	2,370	89,359	1,859	----------
Dry gold and silver ore	176	234.69	3,865	2,792	427	----------
Dry silver ore	22,532	49.11	55,575	205,717	680,158	----------
	31,692	2,516.21	61,810	297,868	682,444	----------
Copper ore	3,124,447	14,442.62	122,093	71,491,246	127,503	----------
Copper-lead ore	2,893	----------	13,600	150,708	509,438	----------
Lead ore	10,678	127.07	54,104	206,714	2,724,711	----------
Lead-zinc ore	215,138	11,872.60	637,510	2,098,412	11,980,646	49,293,000
Zinc ore	57,336	2.40	934	6,915	28,113	10,310,000
	3,410,492	26,444.69	828,241	73,953,995	15,370,411	59,603,000
Total, lode mines	3,442,184	28,960.90	890,051	74,251,863	16,052,855	59,603,000
Total, placers	----------	280.97	32	----------	----------	----------
	3,442,184	29,241.87	890,083	74,251,863	16,052,855	59,603,000

Ore sold or treated in New Mexico in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Colfax	6,328	1,594.54	337	1,687	----------	----------
Grant	111	63.49	186	59	1,859	----------
Otero	372	19.16	60	7,847	----------	----------
Santa Fe	1,563	315.42	1,044	71,512	----------	----------
Sierra	610	239.80	743	8,254	----------	----------
	8,984	2,232.41	2,370	89,359	1,859	----------
Total, 1926	1,660	980.88	299	710	----------	----------

DRY GOLD AND SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Catron	89	226.29	3,591	----------	----------	----------
Grant	31	2.20	105	623	247	----------
Hidalgo	56	6.20	169	2,169	180	----------
	176	234.69	3,865	2,792	427	----------
Total, 1926	2,022	392.66	18,467	7,000	31,900	----------

Ore sold or treated in New Mexico in 1927, by counties, with content in terms of recovered metals—Continued

County	Ore	Gold	Silver	Copper	Lead	Zinc
DRY SILVER ORE						
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Grant	654	42. 23	5, 457	1, 808	3, 475	
Hidalgo	4, 951	1. 29	10, 797	129, 586	908	
Sierra	16	1. 79	2, 145	115	232	
Socorro	16, 911	3. 80	37, 176	74, 208	675, 543	
	22, 532	49. 11	55, 575	205, 717	680, 158	
Total, 1926	22, 194	55. 14	123, 969	17, 025	173, 100	
COPPER ORE						
Eddy	30			2, 390		
Grant	3, 023, 896	4, 754. 34	44, 936	66, 891, 009	123, 946	
Guadalupe	6, 953			611, 893		
Hidalgo	93, 262	9, 500. 00	76, 152	3, 941, 842	3, 557	
Santa Fe	201	18. 48	466	32, 939		
Sierra	105	169. 80	539	11, 173		
	3, 124, 447	14, 442. 62	122, 093	71, 491, 246	127, 503	
Total, 1926	3, 644, 936	17, 509. 81	164, 460	81, 242, 662	37, 868	
COPPER-LEAD ORE						
Grant	2, 833		13, 219	147, 326	487, 755	
Lincoln	60		381	3, 382	21, 683	
	2, 893		13, 600	150, 708	509, 438	
Total, 1926	5		84	250	2, 500	
LEAD ORE						
Dona Ana	218	3. 73	1, 862	1, 923	71, 651	
Grant	4, 806	21. 70	29, 445	182, 056	1, 319, 476	
Hidalgo	671	41. 78	5, 778	4, 991	227, 514	
Luna	1, 125	15. 72	2, 058	367	206, 080	
Otero	329		67	4, 076	72, 126	
Santa Fe	128	7. 20	1, 437	259	66, 410	
Sierra	265	5. 65	6, 873	954	117, 654	
Socorro	3, 136	31. 29	6, 584	12, 088	643, 800	
	10, 678	127. 07	54, 104	206, 714	2, 724, 711	
Total, 1926	22, 508	209. 17	80, 127	361, 282	4, 611, 698	
LEAD-ZINC ORE						
Grant	14, 060	262. 32	50, 077	14, 997	822, 606	128, 000
San Miguel	164, 874	11, 405. 18	509, 446	1, 989, 000	8, 706, 000	42, 445, 000
Santa Fe	15, 000	205. 10	52, 203	13, 809	2, 141, 715	2, 446, 000
Sierra	26				5, 114	12, 000
Socorro	21, 178		25, 784	80, 606	305, 211	4, 262, 000
	215, 138	11, 872. 60	637, 510	2, 098, 412	11, 980, 646	49, 293, 000
Total, 1926	17, 160	343. 18	59, 375	8, 050	1, 892, 700	3, 123, 500
ZINC ORE						
Grant	56, 859				15, 000	10, 142, 000
Socorro	477	2. 40	934	6, 915	13, 113	168, 000
	57, 336	2. 40	934	6, 915	28, 113	10, 310, 000
Total, 1926	115, 409	9. 90	4, 108	5, 400	210, 600	20, 981, 300

METALLURGIC INDUSTRY

The markets for New Mexico ore and concentrates are all outside the borders of the State. Lead ores and concentrates are sold to the American Smelting & Refining Co.'s lead plant,[1] at El Paso, Tex., and to the Copper Queen lead plant at Douglas, Ariz. Copper ore and concentrates are sold to the American Smelting & Refining Co.'s copper plant at El Paso, to the Copper Queen copper smelter at Douglas, and to the Calumet & Arizona copper plant at Douglas. In the past some copper ore has gone to the American Smelting & Refining Co.'s copper plant at Hayden, Ariz. Zinc ore and concentrates are shipped to the United States Zinc Co.'s natural-gas retort plants at Amarillo, Tex., and Henryetta, Okla.; to the Mineral Point Zinc Co.'s producer-gas retort plant at Depue, Ill.; to the Ozark Smelting & Mining Co.'s zinc pigment plant at Coffeyville, Kans.; to the American Metal Co.'s natural-gas retort plant at Blackwell, Okla., and producer-gas retort plant at Langeloth, Pa.; and to the Empire Zinc Co.'s zinc-oxide plant, at Canon City, Colo. Iron ore and iron-manganese ore go to Pueblo, Colo., and manganese ore goes to Birmingham, Ala.

The Grubnau Chemical Co.'s Wetherill grate zinc oxide plant at Waldo, N. Mex., remained idle.

Mine production of metals in New Mexico in 1927, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated [1]	6, 408	1, 481. 12	545			
Concentrates smelted	248, 487	16, 616. 74	656, 690	66, 788, 928	12, 269, 541	59, 279, 000
Ore smelted	180, 164	10, 863. 04	232, 816	7, 462, 935	3, 783, 314	324, 000
Placer		280. 97	32			
		29, 241. 87	890, 083	74, 251, 863	16. 052, 855	59, 603. 000

[1] 250 pounds of quicksilver was used. No ore was cyanided.

Mine production of metals from gold and silver mills in New Mexico in 1927, by counties

County	Ore treated	Recovered in bullion		Concentrates and recovered metal			
		Gold	Silver	Concentrates produced	Gold	Silver	Copper
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
Catron		6. 99	170				
Colfax	6, 328	1, 435. 04	248	30	159. 50	89	1, 687
Grant	80	39. 09	127				
	6, 408	1, 481. 12	545	30	159. 50	89	1, 687
Total, 1926	2, 348	978. 15	7, 459	28	127. 60	39	250

NOTE.—Average recovery per ton in bullion and concentrates: Gold, 0.256 ounce; silver, 0.10 ounce.

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[1] For latest published description see Young, George J., The El Paso Smelter: Eng. and Min. Jour.-Press, vol. 119, 1925, pp. 1041-1047.

Mine production of metals from concentrating mills in New Mexico in 1927, by counties

County	Ore treated	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Grant	3,053,016	171,195	4,817.96	65,786	64,699.166	837,606	10,247,000
San Miguel	164,874	66,971	11,405.18	509,446	1,989,000	8,706,000	42,445,000
Santa Fe	15,000	5,026	205.10	52,203	13,809	2,141,715	2,446,000
Socorro	22,722	5,265	29.00	29,166	85,266	584,220	4,141,000
	3,255,612	248,457	16,457.24	656,601	66,787,241	12,269,541	59,279,000
Total, 1926	3,651,738	192,787	5,520.28	83,641	74,046,350	1,683,000	20,947,000

Mine production of metals from New Mexico concentrates, 1926–27 [1]

Year	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1926	192,815	5,647.88	83,680	74,046,600	1,683,000	20,947,000
1927	248,487	16,616.74	656,690	66,788,928	12,269,541	59,279,000

[1] For figures by counties see preceding tables.

Mine production of metals from New Mexico crude ore shipped to smelters in 1927, by counties

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Catron	89	219.30	3,421	-----	-----	-----
Dona Ana	218	3.73	1,862	1,923	71,651	-----
Eddy	30	-----	-----	2,390	-----	-----
Grant	50,154	289.23	77,512	2,538,712	1,936,758	23,000
Guadalupe	6,953	-----	-----	611,893	-----	-----
Hidalgo	98,940	9,549.27	92,896	4,078,588	232,159	-----
Lincoln	60	-----	381	3,382	21,683	-----
Luna	1,125	15.72	2,058	367	206,080	-----
Otero	701	19.16	127	11,923	72,126	-----
Santa Fe	1,892	341.10	2,947	104,710	66,410	-----
Sierra	1,022	417.04	10,300	20,496	123,000	12,000
Socorro	18,980	8.49	41,312	88,551	1,053,447	289,000
	180,164	10,863.04	232,816	7,462,935	3,783,314	324,000
Total, 1926	171,808	12,874.71	359,750	7,595,779	5,277,366	3,157,800

REVIEW BY COUNTIES AND DISTRICTS

CATRON COUNTY

Mogollon district.—Production in the Mogollon district in 1927 consisted of shipments of clean-up material from the dismantled Last Chance mill. Development work was continued at the Deadwood group, but no ore was extracted. In connection with a lawsuit involving extralateral rights the Mogollon Mines Co. sank 100 feet of shaft on the Ida May vein and 100 feet of shaft on the Trilby vein. The Fanney 200-ton cyanidation mill, closed in January, 1926, remained idle.

Mine production of gold, silver, copper, and lead in Mogollon or Cooney district, Catron County, N. Mex., 1904–1927, in terms of recovered metals [1]

Year	Ore	Gold	Silver	Copper	Lead	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1904	11, 276	$61, 880	79, 014	422, 308		[2] $161, 763
1905	15, 534	97, 158	240, 943	295, 175		[2] 290, 180
1906	16, 076	127, 907	268, 567			[2] 310, 533
1907	20, 698	105, 413	418, 338	150, 000		411, 516
1908	19, 546	116, 418	278, 939			264, 256
1909	23, 945	111, 464	249, 413	46	49	241, 167
1910	50, 514	304, 210	595, 669			625, 871
1911	102, 219	531, 358	1, 067, 038	1, 873	1, 862	1, 097, 206
1912	101, 361	524, 858	1, 093, 158	184	386	1, 197, 197
1913	115, 739	619, 886	1, 306, 766	4, 418	1, 217	1, 409, 912
1914	136, 124	629, 102	1, 410, 327		590	1, 409, 035
1915	119, 710	509, 165	1, 301, 059		2, 426	1, 168, 916
1916	118, 257	373, 068	1, 008. 483	858	3, 232	1, 037, 084
1917	111, 934	258, 620	722, 642	414	1, 593	854, 327
1918	56, 452	119, 710	302, 902	235	282	422, 690
1919	56, 531	148, 136	382, 800	9, 521		578, 643
1920	41, 895	125, 631	329, 489	582	2, 050	485. 045
1921	48, 870	126, 791	310, 774			437, 565
1922	48, 106	142, 133	322, 460			464, 593
1923	47, 644	179, 351	398, 714			506, 296
1924	72, 736	230, 960	618, 094			645, 083
1925	52, 118	163, 322	449, 699			475, 413
1926	976	12, 444	28, 404	24, 400		33, 584
1927	89	4, 678	3, 591			6, 714
Total, 1904–1927	1, 388, 350	5, 623, 663	13, 187, 283	910, 014	13, 687	14, 534, 589

[1] In reports prior to 1921 the production for the Mogollon district will be found under Socorro County.
[2] Revised figures.

COLFAX COUNTY

Mount Baldy district (*Baldy, Elizabethtown, Therma*).—The Maxwell Land Grant Co., which in 1926 took over the operation of its Aztec mine following several years of desultory work on the part of lessees, continued in 1927 the repair work started in 1926 and reopened old stopes, the ore from which was sufficient to operate the mill for nine months in 1927. The remodeled mill has a capacity of 50 tons in 24 hours and is equipped with 1 Universal crusher, 2 Lane Chile-type mills, 4 amalgamating plates, 1 cone classifier, 2 Wilfley tables, 2 J. I. B. flotation machines, and 1 Dorr thickening tank. The development work on this property totals 10,000 feet. The mine was discovered in 1868 and in a few years made an estimated output of between $1,250,000 and $1,500,000. It was then abandoned until 1912. Between 1912 and 1920 it produced $1,680,718 in bullion (ranging in fineness from 0.856 to 0.889 in gold and 0.142 to 0.105 in silver) and $243,079 (mostly gold) in concentrates. Shortly after the discovery of the "bonanza" ore in 1914 the cost of producing gold was as low as $2 an ounce, but in 1919 it rose to $13.50, owing to the large amount of timbering required and to other operating difficulties.[2] From 1920 to 1925, inclusive, the mine was operated by lessees in a desultory manner with occasional production.

Placer deposits in the creeks radiating from Mount Baldy, also discovered about 1868, have had an estimated production to 1927 of $3,000,000 or more, the heaviest production being, of course, in the first 10 years following discovery. Placer mining was fairly active in 1927, producing placers being the Little Nigger hydraulic placer on

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[2] Chase, C. A., and Muir, Douglas, The Aztec Mine, Baldy, N. Mex.: Trans. Am. Inst. Min. and Met. Eng., vol. 68, 1923, pp. 270–281. See also Finlay, J. R., Report of Appraisal of Mining Properties of New Mexico, Santa Fe, State Tax Commission, 1921–22.

Moreno Creek at Elizabethtown, the Maxwell Land Grant hydraulic placers on Ute Creek and on South Ponil Creek, and small sluicing operations on Willow Creek.

Mine production of gold, silver, copper, and lead in Mount Baldy district, Colfax County, N. Mex., 1904–1927, in terms of recovered metals

Year	Ore	Gold		Silver (lode and placer)	Copper	Lead	Total value
		Lode	Placer				
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	
1904	380	$3,638	$90,639	67	----------	----------	$94,316
1905	13	445	31,994	[1] 181	----------	----------	[1] 32,549
1906	----------	----------	14,492	93	----------	----------	[1] 14,555
1907	----------	----------	11,914	83	----------	----------	11,969
1908	----------	----------	11,274	66	----------	----------	11,309
1909	83	1,705	16,037	127	----------	----------	17,808
1910	93	3,433	9,588	261	----------	2,182	13,258
1911	2,306	31,547	9,860	1,254	5,587	----------	42,770
1912	3,025	27,316	8,385	634	6,243	----------	37,121
1913	3,222	15,588	4,550	254	1,147	134	20,475
1914	2,860	63,129	4,930	577	11,083	154	69,858
1915	2,673	350,745	2,631	2,483	14,092	787	357,138
1916	6,064	417,258	5,039	2,803	447	----------	424,251
1917	10,180	342,994	5,739	2,381	4,784	930	352,081
1918	10,031	258,034	2,133	1,880	4,619	----------	[1] 263,188
1919	10,557	238,656	3,885	[1] 1,634	----------	----------	244,371
1920	5,637	81,722	1,634	607	----------	----------	84,018
1921	----------	5,361	3,447	52	----------	----------	8,860
1922	3,730	76,341	1,472	570	----------	----------	78,383
1923	2,315	48,725	1,811	430	592	----------	50,975
1924	----------	242	2,303	15	----------	----------	2,555
1925	2,000	51,688	970	432	----------	----------	52,958
1926	1,572	18,748	1,851	175	250	----------	20,743
1927	6,328	32,962	2,155	353	1,687	----------	35,538
Total, 1904–1927	73,069	2,070,277	248,733	17,412	50,531	4,187	2,341,047

[1] Revised figures.

DONA ANA COUNTY

Organ district.—Small operations in the Organ district in 1927, centering chiefly in the examination and minor development work at the Bennett-Stephenson group, resulted in the shipment of nine cars of lead-silver smelting ore to the El Paso smelter.

EDDY COUNTY

A car of copper ore was shipped from the Lucky Strike group of claims, west of Carlsbad, in sections 14, 15, and 22, range 25 east, township 21 south.

GRANT COUNTY[3]

Burro Mountain district (*Tyrone*).—Company development work in 1927 at the Burro Mountain properties of the Phelps Dodge Corporation, at Tyrone, consisted of 2,112 feet of drifting and crosscutting. Small lease operations in certain blocks of the mine yielded 329 tons of copper oxide smelting ore. The leaching of the 1,000,000-ton waste dump of former years continued, with an output of 245 tons of cement copper, precipitated from the leaching water. The company also experimented in the laboratory with leaching of mixed sulphide and oxide copper ores, following the experiments with a 1,000-pound per day test-plant operation. The 2,000-ton concentration plant on this property remained idle.

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[3] For a description of the geology of Bear Mountain, Burro Mountain, Chloride Flat, Fierro, Fleming, Georgetown, Hanover, Lone Mountain, Pinos Altos, and Santa Rita see Paige, Sidney, U. S. Geol. Survey Geol. Atlas U. S., Silver City folio (No. 199), 1916.

The Woodward or Contact group on Bald Mountain, 2.4 miles from Tyrone, was reopened, and 490 tons of silver ore was shipped from the 170-foot upraise from the adit level. The adit is 700 feet long.

Central district (*Bayard, Fierro, Georgetown, Hanover, Santa Rita*).—The Empire Zinc Co.'s 250-ton magnetic separation mill at Hanover was idle, but the company's new flotation mill was operated all year on zinc tailings from the magnetic mill. The flotation product—zinc concentrate—was shipped to the company's zinc oxide plant at Canon City, Colo. The Hayward-Richard Leasing Co., operators of the Ground Hog mine at Vanadium, drove 1,383 feet of drifts, raises, and crosscuts in the course of routine development, operation, and extraction of ore. The property is opened by a 400-foot vertical shaft. The ore is mixed oxidized and sulphide copper-silver-lead and lead-silver-copper smelting ore. Stauber & Wright shipped mixed oxidized and sulphide copper-lead-silver ore from the Lucky Bill mine at Hanover, opened by a 300-foot shaft, and the Black Hawk Consolidated Mining Co. shipped oxidized lead-silver smelting ore from a 40-foot shaft on the Hobo-"97" group, at Hanover. The Hanover-Bessemer Iron & Copper Co. shipped about 240,000 short tons of magnetite ore from Fierro to the Colorado Fuel & Iron Co. at Pueblo, Colo., and intermittently shipped copper oxidized smelting ore to El Paso, Tex. This group of mines is opened by a 6,000-foot adit.

Development in 1927 consisted of 1,886 feet of drifting and 1,907 feet of raising. On the property is a 1,200-ton magnetic separation mill which was not operated in 1927, except for part of the crushing equipment. Waste was separated by hand picking. The copper ores are malachite, chrysocolla, and cuprite. R. R. Foster shipped oxidized copper smelting ore from the dump of the Copper Flat mine at Hanover. Lessees on the Modoc-Emma group at Fierro shipped oxidized copper ore to El Paso, Tex. Copper sulphide ore was shipped from the Dewey-Schley group at Fierro. A car of copper sulphide smelting ore was shipped from the Philadelphia group at Hanover by the United States Copper Co. During 1927 the Peru Mining Co. (subsidiary of the Illinois Zinc Co.) purchased the holdings of the Hanover Copper Co., north of the Chino Mines and between Santa Rita and Hanover, and also purchased the holdings of the Grant County Copper Co. An adit was started to connect and operate the two properties, an aerial tram was built to the railroad, and construction of a 100-ton flotation mill was begun at Deming to treat the ore, which is lead-zinc sulphide.

The Chino Mines, or the New Mexico division of the Nevada Consolidated Copper Co., were operated the entire year. The mining property is at Santa Rita, and its history of operation dates back to 1804, under the name of Santa Rita del Cobre mine, but its more recent operation is identified by the name of the Chino Copper Co., which acquired the property in 1909 and started open-pit mining with steam shovels. Early in 1924 the Chino Copper Co. sold all its assets to the Ray Consolidated Copper Co., and on May 26, 1926, the Nevada Consolidated Copper Co. acquired the properties and assets of the Ray Consolidated Copper Co., the major items of which were mines and plants in the vicinity of Ray, Ariz., and Santa Rita, N. Mex. The ore of the Chino Mines is mainly sulphide but often partly oxidized, the principal minerals being chalcocite, native copper, and cuprite. The bulk of the ore is low grade (1.326 per cent copper is the published average grade in 1927 for Chino, Ray, and Nevada mines) and is transported by broad-gauge railroad to Hurley, where is located the flotation concentration plant of seven sections, five of which were in operation in 1927, treating approximately 8,170 tons per day. The concentrate produced is smelted to blister copper at the El Paso Smelting Works. Occasionally crude ore of higher grade than the milling ore is shipped direct from the mines to the El Paso smelter. Preparations are well under way at the mine toward underground mining, when that method becomes a necessity.

The Twenty-First Annual Report of the Nevada Consolidated Copper Co., for the year ended December 31, 1927, contains the following with respect to the Chino Mines division:

> At Chino Mines two patented mining claims were acquired during the year for the protection of the water supply wells, and one claim was located to provide additional dump area.
>
> Approximately 25 per cent of the year's tonnage was secured from pit areas which lie outside the previously known ore body, though no development was done to determine the limits of these new ore extensions.
>
> The man and material shaft to serve the underground mining operations of the Estrella and adjacent ore bodies was sunk to its final depth of 678 feet and 348 feet of the shaft concreted. The pump station was completed, as well as the shaft stations at the several mining horizons, and the driving of the haulage ways and mining drifts started. Sinking of the ore hoisting shaft itself is now being carried on, and at the end of the year 69 feet had been sunk and concreted. The concrete flume for the diversion of the waters of Santa Rita Creek around the outside slope of the pit was completed in July and has adequately handled several heavy floods which have been experienced since that date. The fill supporting a new roadway across the south end of the shovel pit was also completed toward the end of the year, as well as the necessary changes in the delivery tracks of the Santa Fe Railroad.
>
> All ores are still mined by power shovels, the mining cost for the year, exclusive of the depreciation and taxes but including all other expenses of every nature, was 34.8 cents per ton. The cost of stripping at the Chino division for the year was 48.54 cents per cubic yard, computed on the same basis.
>
> The mining costs stated above do not include the usual charges made as to all mines against each ton of ore produced to cover prepaid development or stripping expense or both. This charge, for the year under discussion, was at Chino Mines 45 cents per ton.
>
> The coarse crushing plant of the Hurley concentrator was remodeled and the size of the crushed product reduced to minus ¼-inch mesh. Alterations in the fine crushing and fine grinding departments are now being made to take advantage of this finer product, and it is believed that the improvements now in progress will result in a substantial reduction in the milling cost.
>
> At all divisions a very substantial improvement was effected during the year in raising the grade of concentrates through modified methods of introducing flotation reagents. Research work looking toward this end had been actively prosecuted throughout the year, but it was not until nearly its close that the procedure now employed was developed and generally applied in concentrator operations at all divisions. The substantial improvement in the grade of concentrates has been secured without any additional cost in milling operations or material decrease in total mill recovery and will effect a permanent reduction in the cost of smelting over the remaining life of the properties.
>
> At Chino Mines a total of 2,982,137 dry tons of ore was milled through the Hurley concentrator during the year, equivalent to an average of 8,170 tons a day. The cost of milling, exclusive of depreciation and taxes but including all other expenses, was 70.2 cents per ton.
>
> As to both Ray and Chino mines the concentrates produced from the mills and all direct smelting ores obtained from mining operations were smelted at the plants of the American Smelting & Refining Co. at Hayden, Ariz., and El Paso, Tex., respectively.
>
> At Chino Mines production requirements were wholly supplied from shovel operations, which will continue to produce the total ore requirements at this division for the next two years. The opening of the Estrella ore body for underground mining will be continued and the necessary shafts, surface facilities and underground haulage ways driven in the meanwhile, so as to be prepared for production from underground sources well in advance of requirements.

At all divisions property and equipment have been maintained in excellent operating condition, and a definite advance toward increased economy was made during the year in spite of a reduced production. Research work carried on during the year disclosed methods of securing improvements in metallurgical results, more especially as regards the production of a better grade of concentrates; and this, together with the several minor improvements that have been recently installed, will bring about further operating economies during the coming year. Mill recovery and the grade of concentrate produced were higher than in the year previous, and the production per employe engaged exceeded the performance at any previous period when operations were being conducted at corresponding capacities, and still further decreases in cost of production are certain.

Mine production of gold, silver, copper, lead, and zinc in Central district, Grant County, N. Mex., 1904–1927, in terms of recovered metals

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	21, 048	$5, 582	282	3, 264, 208	11, 977	----------	[1] $424, 080
1905	[1] 20, 252	----------	[1] 8	[1] 3, 179, 206	----------	[1] 96, 424	[1] 501, 650
1906	39, 155	4	2, 524	3, 075, 001	235, 070	99, 656	[1] 614, 673
1907	57, 079	5, 659	36, 813	4, 994, 575	855, 358	73, 729	1, 078, 555
1908	41, 852	777	296	3, 994, 502	29, 122	251, 070	541, 231
1909	41, 456	816	1, 380	3, 348, 808	23, 256	203, 278	448, 856
1910	37, 008	----------	404	2, 679, 630	155	1, 285, 500	409, 955
1911	45, 584	104	8, 673	1, 413, 189	605, 978	290, 122	[1] 225, 156
1912	1, 136, 290	998	29, 586	29, 512, 812	2, 172, 676	2, 205, 824	5, 138, 779
1913	1, 948, 471	9, 697	12, 500	51, 695, 656	331, 440	2, 187, 266	8, 167, 144
1914	1, 934, 020	102, 971	42, 971	55, 222, 874	365, 079	3, 669, 513	7, 672, 759
1915	2, 395, 795	102, 379	73, 267	66, 581, 366	1, 542, 234	5, 628, 870	12, 561, 729
1916	3, 134, 791	133, 962	116, 953	74, 228, 606	2, 122, 797	7, 278, 575	19, 592, 956
1917	3, 668, 289	138, 873	121, 386	82, 200, 421	2, 250, 337	7, 398, 853	23, 627, 822
1918	3, 908, 816	128, 577	111, 175	77, 547, 300	2, 857, 887	8, 826, 967	20, 400, 099
1919	1, 789, 083	57, 280	34, 508	40, 358, 634	1, 283, 642	4, 299, 658	7, 984, 543
1920	1, 882, 172	68, 962	26, 190	44, 400, 088	925, 513	6, 134, 593	8, 838, 068
1921	362, 331	10, 439	9, 688	9, 138, 442	4, 422	95, 000	1, 203, 935
1922	1, 426, 783	24, 537	11, 326	28, 408, 184	[1] 352, 640	1, 333, 440	3, 966, 369
1923	2, 885, 711	68, 108	29, 264	54, 374, 770	1, 311, 141	13, 017, 000	9, 062, 131
1924	2, 859, 688	71, 121	38, 200	66, 824, 015	1, 183, 626	16, 921, 000	10, 045, 216
1925	3, 159, 167	97, 299	76, 547	68, 812, 280	2, 363, 260	15, 033, 000	11, 269, 879
1926	3, 633, 821	109, 335	86, 963	75, 219, 200	2, 611, 100	14, 327, 000	11, 977, 701
1927	3, 087, 823	98, 963	85, 963	66, 971, 008	1, 907, 476	10, 076, 000	9, 685, 941
Total, 1904–1927	39, 516, 485	1, 236, 443	956, 867	917, 444, 775	25, 346, 186	120, 732, 338	175, 439, 227

[1] Revised figures.

Chloride Flat district (*Silver City*).—The Chloride Flat district, whose silver-lead ores contributed to the founding of Silver City, produced no silver-lead ores in 1927, but the Manganese & Fluorspar Producers Corporation continued to ship iron-manganese ore from the Boston Hill group and from the Clan-Seven Sisters-Legal Tender group to the Colorado Fuel & Iron Co.'s plant at Pueblo, Colo., and the Colorado Fuel & Iron Co. mined iron-manganese ore from the Silver Spot group and shipped it to Pueblo, Colo.

Eureka (*Hachita*) *district* (*see also Eureka district, Hidalgo County*).—The American Group of Mines Co.'s flotation mill, located at the mine 8 miles west of Hachita, was operated part of 1927 on lead-zinc-iron ore from the American Group mine. Concentrates produced were lead, lead-zinc, and iron-silver. The mine is opened by a 200-foot shaft inclined at an angle of 70°. Approximately 3,000 feet of development work was done in 1927. Lessees on the Hornet mine shipped one car of lead-silver ore to the El Paso smelter.

Gold Hill district.—Frank G. Cline, working alone on several outcrops at Gold Hill, with a small amalgamating mill, made several small shipments of gold and silver bullion to the Denver mint.

Pinos Altos district.—The Calumet-New Mexico gravity-concentration mill was operated part of 1927 on lead-zinc-iron ore, producing lead, zinc, and iron-gold-silver concentrates. Lessees on the "Houston Thomas" group shipped one car of lead-silver smelting ore. The Jackson Consolidated gravity concentrating mill was operated for a very short time on lead-zinc-iron ore from the Langston mine, producing lead, zinc-lead, and iron-gold-silver concentrates. One car of lead-silver oxidized smelting ore and one of zinc oxidized smelting ore were shipped from the Lead Hill claim. Surface deposits at Pinos Altos yielded, chiefly after heavy rains, small pannings of placer gold, totaling 44.44 crude ounces averaging 0.754 in gold fineness and 0.225 in silver fineness.

Mine production of gold, silver, copper, lead, and zinc in Pinos Altos district, Grant County, N. Mex., 1904–1927, in terms of recovered metals

Year	Ore	Gold		Silver	Copper	Lead	Zinc	Total value
		Lode	Placer					
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	4,719	$49,660	$7,750	37,229	104,069	2,653	----------	[1] $92,438
1905	6,348	31,442	10,943	39,585	103,469	----------	160,779	[1] 92,159
1906	14,074	89,674	2,290	83,566	328,788	----------	----------	[1] 212,245
1907	14,841	78,723	3,782	65,862	322,195	----------	----------	190,413
1908	1,451	8,548	1,479	8,941	34,514	3,953	----------	19,488
1909	38	2,083	3,584	1,377	6,200	418	----------	7,207
1910	20	1.372	2,494	223	269	2,226	----------	4,119
1911	355	1,406	4,043	5,616	3,232	4,063	16,773	9,968
1912	6,169	7,973	2,551	15,864	96,507	50,289	929,176	102,581
1913	3,643	29,162	1,646	28,276	100,555	83,067	366,056	87,626
1914	3,686	[2]114,181	[2]21,560	23,256	129,587	29,994	48,840	169,497
1915	7,024	31,823	1,979	[1] 19,884	377,463	130,638	454,710	172,463
1916	46,471	11,775	2,009	17,816	122,716	152,696	6,741,925	[1] 969,649
1917	45,993	7,731	3,153	10,803	49,945	80,989	5,556,892	607,189
1918	28,983	1,972	672	2,243	12,227	40,028	3,013,802	[1] 285,005
1919	2,912	5,044	1,074	2,524	14,452	20,906	267,671	32,281
1920	1,444	3,168	554	2,000	2,456	40,325	43,247	13,083
1921	----------	----------	2,368	37	----------	----------	----------	2,405
1922	7,880	19,142	2,079	55,820	26,193	673,847	----------	117,639
1923	2,968	12,988	1,300	17,404	68,129	90,471	44,000	47,899
1924	387	2,164	1,042	1,979	4,320	62,135	----------	10,069
1925	407	95	529	2,287	430	96,550	----------	10,672
1926	3,488	5,532	639	4,578	8,400	152,800	170,000	35,178
1927	5,219	5,332	693	4,591	12,206	142,492	130,000	27,524
Total, 1904–1927	208,520	520,990	80,213	451,761	1,928,322	1,860,540	17,943,871	3,318,797

[1] Revised figures.

[2] Output from surface lode mines included with placer. Only a small quantity recovered by actual placer methods. Fineness so similar, separation not practicable.

Steeple Rock district (*16 miles east of Duncan, Ariz.*).—The Carlisle group was unwatered in 1927. Drifting was done on the 500-foot level, a winze from the 500 to the 600 foot level was extended to 700 feet; and drifts and crosscuts were run on the 700-foot level.

Swartz (*or Carpenter*) *district.*—The Black Range Mining Corporation in 1927 remodeled the mill at the Royal John mine, 20 miles east of Santa Rita. Only a few days run was made in 1927; the product was a car of zinc concentrates.

GUADALUPE COUNTY

I. J. Stauber continued to ship oxidized copper ore from a surface deposit in sections 6 and 7, township 7 north, range 20 east, near Pastura. The ore contained 4.6 per cent copper. This property is opened by eight vertical shafts each 25 to 35 feet deep and two inclined shafts 60 to 100 feet deep. In 1927 he drove 1,600 feet of development work but did not ship as strongly as he might, as he was awaiting a higher copper price.

HIDALGO COUNTY

Eureka district (Hachita) (see also Eureka district, Grant County).—The Apache Leasing Co. shipped eighty 60-ton cars of lime rock, carrying approximately 47 per cent CaO, 1.5 ounces silver, and 1.5 per cent copper, from the Apache mine, south of Hachita, to the El Paso smelter. This mine is locally said to be in the Apache subdistrict. A car of copper-silver smelting ore was shipped from the Cochise mine.

Fremont district (Hachita) (see also Fremont district, Luna County).—Assessment work was done at the Canovello, Rattlesnake, and Volney groups in 1927.

Gillespie (or Red Hill) district (Hachita).—Development work begun in 1926 on the Red Hill group by the Western Development Exploration & Mining Co., lessees, of Denver, Colo., was continued until August, 1927, when the lease was abandoned. The shaft was sunk from 300 to 476 feet. No ore was shipped in 1927. This property is 28 miles southwest of Hachita.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts).—Shipments of highly siliceous gold-silver-copper ore for use in the copper converter linings of smelters at Douglas, Ariz., continued at approximately the same rate as in 1923 to 1926. The largest producing mine in the district in 1927 was the Eighty-Five branch of the Calumet & Arizona Mining Co., which also has mines at Warren, Ariz., and a custom copper smelter at Douglas, Ariz. The Eighty-Five group is opened by a 1,650-foot vertical shaft and 15,000 feet of drifts. Development work in 1927 amounted to 6,525 feet. Lessees on the Bonney group shipped similar siliceous ore to the Copper Queen copper smelter at Douglas, Ariz. Several shipments of lead-silver-gold ore were made to the Copper Queen lead smelter at Douglas, Ariz., and to the lead smelter at El Paso, Tex.

Mine production of gold, silver, copper, and lead in Lordsburg district, Hidalgo County, N. Mex., 1904–1927, in terms of recovered metals [1]

Year	Ore	Gold	Silver	Copper	Lead	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1904	250	$1,208	2,580	18,200	12,000	[2] $5,550
1905	366	10	7,584	48,000	----------	[2] 12,124
1906	1,743	5,168	27,261	212,601	----------	[2] 64,737
1907	5,645	8,761	31,303	463,335	10,522	122,646
1908	7,532	10,617	9,889	259,079	[2] 11,373	50,534
1909	10,690	25,983	50,154	589,969	8,862	129,140
1910	29,220	59,798	130,324	1,627,591	19,662	337,742
1911	46,139	106,648	182,448	2,455,336	2,157	510,359
1912	55,340	144,859	275,251	3,155,585	4,562	835,015
1913	31,284	55,234	154,779	1,601,461	14,572	397,588
1914	38,964	101,080	232,647	2,614,674	30,049	578,658
1915	92,093	222,848	374,325	3,890,365	28,723	1,094,795
1916	118,966	267,148	373,074	4,755,179	30,478	1,684,508
1917	99,532	245,607	295,443	4,261,956	41,442	1,656,130
1918	55,015	130,858	153,236	2,214,996	17,831	832,464
1919	77,002	175,008	242,733	3,516,457	53,264	1,103,753
1920	55,307	153,461	182,000	2,695,674	98,312	[2] 855,710
1921	11,593	22,987	35,119	579,295	13,134	133,426
1922	61,291	114,911	107,511	3,216,585	102,291	662,287
1923	96,587	216,551	141,538	4,314,122	46,185	970,024
1924	88,472	192,203	113,591	4,927,878	40,412	917,094
1925	108,219	222,823	126,781	5,064,140	69,700	1,035,981
1926	97,420	241,954	126,909	4,762,750	73,400	993,802
1927	93,406	197,333	77,155	3,933,496	46,381	759,290
Total, 1904–1927	1,282,076	2,923,061	3,453,635	61,178,724	775,312	15,743,357

[1] In reports prior to 1920 the production for the Lordsburg district will be found under Grant County.
[2] Revised figures.

Steins district.—Several cars of silver-lead smelting ore, with occasional minor content of gold and copper, were shipped from the Charles, Granite Hill, and Silver Hill groups to El Paso, Tex., and Douglas, Ariz.

LINCOLN COUNTY

Two carloads of lead-silver ore were shipped to El Paso from the Gallinas Mountains district. No production was made in 1927 from the Jicarilla, Nogal, and Whiteoaks districts.

LUNA COUNTY

Cooks Peak district (north of Deming).—Several hundred tons of lead-silver oxidized smelting ore was shipped by lessees to the El Paso smelter from the Desdemona-Othello-Monte Christo group between January 1 and May 31, 1927, when operations were suspended. This group is opened by numerous old vertical shafts 40 to 200 feet deep and by 4,000 feet of drifting.

Florida Mountains district.—Several cars of lead-silver ore from the Bradley group and other prospects in the Florida Mountains, south of Deming, were shipped in 1927 to the El Paso smelter.

Fremont district (Hachita) (see also Fremont district, Hidalgo County).—Assessment work was done at the Keno group.

Tres Hermanas district (Columbus).—Assessment work was done at several properties in the Tres Hermanas district, north of Columbus.

Victorio district (Gage).—One car of lead-silver smelting ore was shipped from the Chance group, near Gage.

OTERO COUNTY

Orogrande district.—Elmer & Strong, lessees and optionees beginning in September, 1927, shipped about 400 tons of mixed sulphide and oxidized iron-copper-gold-silver ore to the El Paso smelter from the old By Chance mine at Orogrande. The property is opened by a vertical shaft 175 feet deep and by 600 feet of drifts.

Sacramento Mountains district (Alamogordo).—Stewart & Holmes, lessees on the Alamo group, did 250 feet of development work in 1927 and shipped several cars of lead ore, carrying very minor contents of silver and copper. The property is between Alamo and Caballero Canyons, east of Alamogordo, and is 10 miles from Oliver Lee station on the Southern Pacific Railroad.

SANDOVAL COUNTY

At the Spanish Queen group in the Jemez mining district near Jemez Springs operations in 1927 included the sinking of a shaft 90 feet and the installing of a 15-ton Mace furnace as a test plant. Total development at the end of 1927 is reported as 90 feet of shaft, 100 feet of drifts, and a 300-foot adit.

SAN MIGUEL COUNTY

The American Metal Co.'s 600-ton selective flotation mill built in 1926 in Alamitos Canyon, 6 miles by road from Glorieta and 4 miles by railroad spur from Fox station on the Atchison, Topeka & Santa Fe Railroad, was set in operation on January 20, 1927, and averaged 480 tons per day during the rest of the year. The mill (called the Pecos) is connected by a 12-mile tram with the Pecos mine (variously known since 1878 as the Cowles, Hamilton, or Goodrich-Lockhart mine, and as the Katydid, Evangeline, and other claims), at the junction of Pecos River and Willow Creek. The post office at the mine is called Tererro. The ore minerals are sphalerite, galena, chalcopyrite, and pyrite, and the gangue is sheared micaceous diorite. One of the chief problems in milling is to remove the sericite and talc. The development and sampling indicated that the ore would average about 18 per cent zinc, 4 per cent lead, 1 per cent copper, $2 silver, and $2 gold. The actual heads in 1927 averaged 0.124 ounce gold, 4.16 ounces silver, 3.78 per cent lead, 1.04 per cent copper, and 17.86 per cent zinc. From 164,874 tons treated in 1927 were made 50,433 tons of zinc concentrate (averaging 0.087 ounce gold, 4.06 ounce silver, 1.52 per cent lead, 1.28 per cent copper, and 50.7 per cent zinc) and 16,538 tons of lead concentrate (averaging 0.478 ounce gold, 21.13 ounces silver, 28.34 per cent lead, 4.27 per cent copper, and 13.1 per cent zinc).

Lead concentrates were shipped in 1927 to the American Smelting & Refining Co's lead plant at El Paso, Tex. Zinc concentrates were shipped to the Blackwell Zinc Co. (American Metal Co.) natural-gas retort plant at Blackwell, Okla., and to the American Zinc & Chemical Co. (American Metal Co.) at Langeloth, Pa. Zinc residues from Blackwell went to El Paso, Tex., and from Langeloth to Chrome, N. J.

The ore is crushed at the mine by one 30 by 18 inch jaw crusher, two 6 by 10 inch gyratory crushers, and one set of 54 by 20 inch Garfield rolls. The mill is equipped with 3 No. 75 Marcy mills, 3 Dorr Duplex 6-foot classifiers, 24 standard Wilfley tables, 100 M. S. Sub. A 18-inch flotation cells, three 8 by 12 foot Oliver filters, and three 40 by 10 foot Dorr thickening tanks.

The power for both mine and mill is electric, made at the 3,000 kw. (two 1,500-kw. units) steam turbine plant adjacent to the mill. The fuel used is New Mexico bituminous coal, powdered.

The mine is opened by a 536-foot vertical shaft and by 4,153 feet of drifts and crosscuts, of which 166 feet of shaft and 3,306 feet of drifts and crosscuts were done in 1927. The mining method includes both the cut-and-fill system and square sets.

SANTA FE COUNTY

Cerrillos district.—From the Evelyn Gold Copper group 5½ miles north of Cerrillos over 1,000 tons of copper-gold oxidized ore was shipped in 1927 to the El Paso copper smelter. The shaft was sunk to 200 feet.

New Placers district (*Golden, San Pedro*).—The Carnahan 50-ton selective flotation mill was operated on the coarsely crystalline sphalerite-galena-pyrite ore of the Amazon-Anaconda-Lincoln-Lucky group near San Pedro. The products continued to be a high-grade silver-lead concentrate nearly free of zinc and a zinc concentrate fairly free of lead and silver. This mine is 12 miles from the railroad station at Hagan. Coal from Hagan is hauled to the mine to make power. The property is opened by a 500-foot vertical shaft. A single lessee on the San Pedro mine shipped several cars of copper-silver-gold ore obtained by sorting old mine dumps and by a little mining on the property. This mine is part of the property of the Santa Fe Gold & Copper Co., which owns 33,479 acres of lands, of which 279 acres are patented copper claims. When worked by the company from 1900 to 1917, the copper mine was opened by a 200-foot shaft and a 1,600-foot adit. In the course of examination by drilling of placer ground on the Ortiz grant near Golden several lots of placer gold averaging 0.9205 in gold fineness and 0.053 in silver fineness were recovered and sold to the Denver Mint.

SIERRA COUNTY

The total calculated gross value of the recoverable gold, silver, copper, lead, and zinc from ores shipped from Sierra County in 1927 was $25,663, as compared with $99,744 in 1926.

Apache, Cuchillo Negro district (*Chloride*).—One car of lead-silver ore was shipped from the Cuchillo mines and one from the Silver Monument mine.

Kingston district.—One car of lead sulphide smelting ore and one of zinc-lead sulphide smelting ore were shipped from the Belle Burke group by the Black Range Development Co. A small lot of silver smelting ore was shipped from the Lady Franklin mine.

Lake Valley district.—The major part of the production of Sierra County in 1926 was oxidized iron-manganese-silver-lime flux from the old Lake Valley mine, but this operation ceased on October 1, 1926, and only one small lot of ore was shipped from the Lake Valley district in 1927.

Las Animas district (*Hillsboro*).—Lessees on the Empire-Bonanza mine shipped two cars of gold-silver-copper ore to El Paso, Tex. A lessee on the dump of the Wicks mine shipped nearly 600 tons of gold ore to El Paso.

Macho district (*Lake Valley*).—Several cars of silver-lead ore were shipped by a lessee on the Anniversary mine on Macho Creek, 10 miles northwest of Nutt station. The mine is opened by a 500-foot shaft, but only 100 feet of water was kept pumped out. A small experimental mill, consisting of a grizzly, trommel screen, picking belt, hand jig, and storage tanks, was erected at this property in 1927.

Pittsburg district (*Hot Springs*).—Various small lots of lead-silver ore and two cars of copper ore were shipped from prospects in the Caballos Mountains, north of Hatch.

Mine production of gold, silver, copper, lead, and zinc in Sierra County, N. Mex., 1904–1927, in terms of recovered metals

Year	Ore	Gold		Silver	Copper	Lead	Zinc	Total value
		Lode	Placer					
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	1, 295	$51, 617	$22, 979	17, 055	16, 700	----------	----------	[1] $86, 626
1905	[1] 3, 513	51, 164	47, 878	8, 760	46, 664	----------	----------	[1] 111, 666
1906	3, 246	16, 539	1, 509	8, 102	5, 995	----------	----------	[1] 24, 714
1907	700	7, 629	595	2, 250	5, 425	9, 548	----------	11, 300
1908	680	16, 039	1, 979	8, 589	12, 874	6, 075	----------	24, 524
1909	4, 294	10, 450	----------	25, 698	25, 838	49, 023	----------	29, 280
1910	8, 306	11, 113	584	15, 778	2, 448	11, 274	----------	21, 024
1911	5, 036	26, 962	823	16, 487	5, 374	28, 088	----------	38, 459
1912	252	2, 597	1, 546	11, 236	8, 988	21, 001	----------	13, 481
1913	269	434	423	2, 529	2, 568	32, 685	----------	4, 221
1914	98	1, 305	442	3, 982	14, 436	5, 743	----------	6, 093
1915	438	1, 079	1, 757	316	2, 228	24, 617	7, 492	5, 472
1916	935	1, 468	----------	2, 138	14, 427	126, 609	7, 045	16, 104
1917	619	1, 470	331	8, 712	11, 828	80, 116	----------	19, 099
1918	801	568	----------	18, 536	42, 053	25, 915	----------	31, 331
1919	4, 041	3, 948	----------	67, 658	31, 661	49, 679	----------	88, 247
1920	6, 957	15, 896	----------	117, 089	43, 826	84, 264	----------	158, 328
1921	3, 856	1, 323	----------	77, 366	1, 395	40, 934	----------	80, 711
1922	9, 965	2, 708	----------	136, 842	38, 771	8, 746	----------	145, 265
1923	6, 441	6, 443	----------	80, 814	61, 469	12, 842	----------	82, 645
1924	42	527	----------	1, 297	3, 787	4, 901	----------	2, 284
1925	2, 545	1, 825	----------	23, 090	6, 300	38, 930	----------	22, 132
1926	19, 658	4, 592	----------	107, 973	16, 680	298, 800	20, 500	99, 744
1927	1, 022	8, 621	----------	10, 300	20, 496	123, 000	12, 000	25, 663
Total, 1904–1927	85, 009	246, 317	80, 846	772, 597	442, 231	1, 082, 790	47, 037	1, 148, 413

Revised figures.

SOCORRO COUNTY

Magdalena district (*Kelly, Magdalena*).—Changes made at the Ozark mill in 1927 by the replacing of a Chilean mill with a ball mill and of Janney flotation machines with Mineral Separation machines, coupled with finer grinding, raised the grade of zinc concentrate from 48 to 52 per cent. The ore was ground to pass all through 65 mesh and 80 per cent through 200 mesh. The zinc sulphide ore, containing also 1 to 3 per cent lead, was bulk floated, the lead being separated from the zinc-lead flotation product by tables. The mill was operated from January 1, 1927, to August 15, 1927; during that time no zinc concentrate was marketed but stored until January, February, and March, 1928. The 1927 product has been entered in the statistics in this report.

In addition to the mining of this zinc sulphide milling ore containing some lead the Ozark Smelting & Mining Co. also mined a zinc-lead sulphide ore in which both the zinc content and the lead content were above the respective content in the mill ore. This class of ore was shipped to the Ozark company's zinc-lead pigment plant at Coffeyville, Kans. The company also mined lead-silver oxidized ores, which were sold to the El Paso smelter. An interesting operation at Kelly in 1927 was the tabling and floating of lead carbonate ores of the Black Cloud mine. The ore is chiefly cerussite in a quartz gangue with some unaltered galena, a small amount of iron oxides, and occasionally anglesite.

After experimenting it was decided to combine table concentration with flotation, in which one-half the table discard went to waste, and one-half to flotation. The flow sheet is as follows: A No. 2½ Wheeling forced-feed crusher crushes the mine-run ore to pass a 1-inch grizzly. The crushed product is fed directly to a 5 by 4 Marcy ball mill in circuit with a Dorr rake classifier. The rake-classifier overflow with a dilution of 1 to 1 is fed directly into a Fahrenwald hydraulic classifier to classify the table feed and separate the slime for flotation. Three electrically driven Deister Plato-O sand tables are used for table concentration. Middlings from the sand table are returned by a 1-inch Krogh sand pump to the ball-mill circuit. The slime from the Fahrenwald classifier is conveyed to a 5-foot agitator, where the lead carbonates are sulphidized.

Tests indicated that only a short time of contact is required before sending to flotation. From the agitator the slime is passed to a 4-cell Kraut flotation machine. A concentrate is taken from the first cell of this machine. The middling from the last three cells is elevated to the head of the machine. The reagents used are sodium sulphide, 5 pounds per ton; xanthate, 0.12 pound per ton; T & T mixture, 0.05 pound per ton; and Yarmour pine oil, 0.1 pound per ton. This equipment was installed in the building erected several years ago to house a dry concentrating process, shortly abandoned.[4] The new plant was ready for operation about April 25, 1927, and yielded several hundred tons of 45 per cent lead concentrate.

Lessees on the Kelly mine of the Empire Zinc Co. also operated a mill for tabling lead carbonate ores from January 1 to April 1, 1927. This mill is equipped with a Blake-type crusher, hydraulic classifiers, and three No. 6 Wilfley tables with special (Hughes) riffles. This mill made lead concentrate averaging 43 per cent lead. Lead oxidized smelting ore was also shipped from the Kelly mine. Several cars each of lead sulphide and zinc sulphide smelting ore were shipped from the Juanita mine and several cars of lead-silver smelting ore from the South Juanita mine. Several hundred tons of zinc-sulphide ore was shipped from the Nitt mine. R. R. Foster shipped 3,000 tons of dump material from the Black Cloud tailings pile, the Juanita mine dump, the old Kelly smelter slag dump, the Socorro slag dump, and the Hardscrabble mine dump. The El Paso Smelting Works also removed over 10,000 tons of the old Socorro smelter slag dump for use as a flux and for its silver and lead content. A car of lead-silver smelting ore was shipped from the eastern side of the Magdalena Mountains, from Water Canyon station.

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[4] For description of mine and mill plant see Duling, John F., Tabling and Floating a Carbonate Lead Ore: Eng. and Min. Jour., vol. 124, No. 6., Aug. 6, 1927, pp. 204-207.

Mine production of gold, silver, copper, lead, and zinc in Magdalena district, Socorro County, N. Mex., 1904–1927, in terms of recovered metals

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	27, 998	$154	5, 024	3, 200	688, 209	[1]13, 493, 835	[1] $721, 257
1905	30, 411	--------	4, 800	320, 000	390, 000	14, 630, 051	[1] 934, 351
1906	35, 478	--------	2, 515	64, 560	238, 088	17, 044, 163	[1] 1, 067, 435
1907	3, 630	13	4, 406	24, 045	707, 981	676, 356	85, 158
1908	6, 319	72	460	2, 605	16, 073	3, 325, 446	157, 631
1909	30, 724	435	17, 925	170, 792	3, 085, 279	12, 878, 241	860, 051
1910	42, 232	468	[1] 65, 880	152, 181	3, 451, 228	16, 727, 870	1, 110, 529
1911	25, 840	352	42, 773	77, 448	2, 123, 039	9, 930, 281	694, 266
1912	[1] 22, 590	746	32, 792	69, 532	2, 192, 792	9, 962, 478	818, 473
1913	47, 647	3, 942	40, 212	278, 252	2, 198, 030	13, 267, 811	911, 069
1914	51, 595	2, 265	14, 436	214, 722	674, 205	13, 785, 176	768, 144
1915	75, 401	488	56, 897	1, 406, 789	2, 031, 297	18, 437, 218	2, 657, 209
1916	78, 669	2, 036	72, 877	993, 199	4, 421, 290	19, 312, 179	3, 187, 217
1917	100, 709	2, 186	137, 114	2, 690, 381	4, 885, 210	14, 716, 745	2, 770, 878
1918	56, 295	430	49, 835	585, 482	3, 033, 535	11, 501, 879	1, 456, 931
1919	13, 938	10	30, 117	599, 382	819, 566	2, 995, 740	407, 352
1920	17, 235	--------	18, 367	311, 663	873, 012	3, 764, 235	452, 110
1921	412	--------	155	------------	60, 711	133, 000	9, 537
1922	8, 304	207	6, 156	8, 063	923, 541	3, 119, 298	236, 046
1923	10, 117	455	15, 721	50, 388	1, 506, 829	3, 421, 000	358, 859
1924	11, 128	199	10, 643	94, 626	1, 636, 825	3, 823, 800	399, 219
1925	12, 356	1, 154	25, 073	82, 800	2, 434, 600	3, 170, 000	483, 042
1926	43, 414	606	14, 575	56, 714	1, 400, 200	8, 013, 300	730, 654
1927	41, 702	775	70, 478	173, 817	1, 637, 667	4, 430, 000	450, 199
Total, 1904–1927	794, 144	16, 993	739, 231	8, 430, 641	41, 429, 207	222, 560, 102	21, 727, 617

[1] Revised figures.

TAOS COUNTY

Red River district.—No production was made in the Red River district in 1927, but the Buffalo-New Mexico Mines Co. cleaned out its adit and sunk the shaft 60 feet. Assessment work was done at the Golden Treasure group, Goose Creek Chief, Homestake, Independence, Placer Creek group, and Silver Tip group.

Sulphur Creek district.—Molybdenum ore from the Phyllis group was milled at the 20-ton flotation mill at the junction of Sulphur Creek and Red River, above Questa.

VALENCIA COUNTY

Surface improvements were made in 1927 at the Valencia copper property at Diener.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

The mine production of gold, silver, copper, lead, and zinc in Texas from 1885 to 1927 has been as follows:

Mine production of gold, silver, copper, lead, and zinc in Texas, 1885–1927, in terms of recovered metals

Year	Ore (short tons)	Gold	Silver	
			Fine ounces	Value
1885–1890	(1)	$6, 906	1, 670, 720	$1, 652, 225
1891–1900	(1)	30, 682	4, 332, 214	2, 979, 288
1901–1910	(1)	3, 372	3, 950, 644	2, 266, 537
1911–1920	431, 997	2, 647	5, 340, 156	4, 027, 083
1921	58, 527		516, 766	516, 766
1922	69, 420		644, 980	644, 980
1923	78, 610	802	811, 824	665, 696
1924	84, 744		720, 739	482, 895
1925	72, 737		552, 000	383, 088
1926	34, 042	2, 270	447, 237	279, 076
1927	50, 759	8, 192	1, 034, 866	586, 769
Total, 1885–1927	(1)	54, 871	20, 022, 146	14, 484, 403

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1885–1890							$1, 659, 131
1891–1900	42, 000	$5, 376	7, 385	$318			3, 015, 664
1901–1910	35, 383	4, 647	295, 018	13, 611	95, 957	$5, 262	2, 293, 429
1911–1920	249, 060	52, 034	874, 155	40, 762	1, 392, 517	101, 229	4, 223, 755
1921							516, 766
1922	4, 290	579	8, 016	441			646, 000
1923	4, 257	625	26, 605	1, 862			668, 985
1924							482, 895
1925			16, 000	1, 392			384, 480
1926	12, 620	1, 767	83, 890	6, 711			289, 824
1927	21, 458	2, 811	487, 984	30, 743			628, 515
Total, 1885–1927	369, 068	67, 839	1, 799, 053	95, 840	1, 488, 474	106, 491	14, 809, 444

[1] Figures not available.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver prices for 1885 to 1915 are from the report of the Director of the Mint and represent the equivalent value per fine ounce based on average price and average rate of exchange; for 1916 and 1917, dealers' buying price, New York; for 1918, early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper prices for 1885 to 1915 are those at New York; for 1916 and later years, weighted average price, for each year, of all grades of primary metal sold by producers. The lead prices for 1885 to 1915 are those at New York; for 1916, outside spot quotations, New York; for 1917 and later years, weighted average price, for each year, of all grades of primary metal sold by producers. The zinc prices for 1885 to 1903 are those at New York; for 1904 to 1914, those at St. Louis; for 1915 and later years, weighted average price, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1885–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1885	$1.07	$0.108	$0.04	$0.043	1907	$0.66	$0.20	$0.053	$0.059
1886	.99	.111	.046	.044	1908	.53	.132	.042	.047
1887	.98	.138	.045	.046	1909	.52	.13	.043	.054
1888	.94	.168	.044	.049	1910	.54	.127	.044	.054
1889	.94	.135	.039	.05	1911	.53	.125	.045	.057
1890	1.05	.156	.045	.055	1912	.615	.165	.045	.069
1891	.99	.128	.043	.05	1913	.604	.155	.044	.056
1892	.87	.116	.041	.046	1914	.553	.133	.039	.051
1893	.78	.108	.037	.04	1915	.507	.175	.047	.124
1894	.63	.095	.033	.035	1916	.658	.246	.069	.134
1895	.65	.107	.032	.036	1917	.824	.273	.086	.102
1896	.68	.108	.03	.039	1918	1.00	.247	.071	.091
1897	.60	.12	.036	.041	1919	1.12	.186	.053	.073
1898	.59	.124	.038	.046	1920	1.09	.184	.08	.081
1899	.60	.171	.045	.058	1921	1.00	.129	.045	.05
1900	.62	.166	.044	.044	1922	1.00	.135	.055	.057
1901	.60	.167	.043	.041	1923	.82	.147	.07	.068
1902	.53	.122	.041	.048	1924	.67	.131	.08	.065
1903	.54	.137	.042	.054	1925	.694	.142	.087	.076
1904	.58	.128	.043	.051	1926	.624	.14	.08	.075
1905	.61	.156	.047	.059	1927	.567	.131	.063	.064
1906	.68	.193	.057	.061					

REVIEW BY COUNTIES

CULBERSON COUNTY

Lessees on the Hazel mine dump, 14 miles north of Van Horn, shipped nearly 2,500 tons of dry silver ore, carrying less than 0.5 per cent copper.

HUDSPETH COUNTY

Two cars of dry silver ore were shipped from the Little Lightning mine, 7 miles north of Allamoore.

PRESIDIO COUNTY

The new ore opened between September, 1926, and February 22, 1927, at the Presidio mine, supplemented by other new ore opened by new development, allowed the 175-ton cyanidation-gravity concentration mill to be operated steadily throughout the remainder of 1927, with the result that the recovered content of silver was over 1,000,000 ounces, the largest yearly output in the history of the mine, dating back to its beginning in 1884. The mine is opened by two vertical shafts, one 400 and the other 700 feet deep, and by 25 miles of drifts and crosscuts, of which 6,158 feet were driven in 1927. The ore is oxidized, the principal mineral being silver chloride, with which are argentite, galena, and probably cerussite, in a quartz gangue.

ZINC

By Elmer W. Pehrson[1]

GENERAL SUMMARY

Salient figures of the zinc industry in the United States, 1926 and 1927

	1926	1927
Production of primary zinc:		
From domestic ores ..... short tons	611,991	576,960
From foreign ores ..... do	6,431	15,556
	618,422	592,516
Apparent consumption of primary zinc ..... do	557,026	516,373
Stocks of zinc on hand at smelters Dec. 31 ..... do	26,937	53,522
Ratio of electrolytic zinc to total primary zinc production ..... per cent	18.05	19.01
Recovery of unalloyed secondary zinc ..... short tons	64,570	64,800
Prices per pound of prime western zinc at St. Louis:		
Average for year ..... cents	7.37	6.25
Highest monthly average ..... do	8.45	6.71
Lowest monthly average ..... do	6.82	5.73
Mine production of recoverable zinc ..... short tons	774,563	718,541
Tri-State district (Joplin region) ..... per cent of total	55	46
Western States ..... do	28	32
Other ..... do	17	22
World smelter production of zinc ..... short tons	1,350,000	1,444,000

The production of primary zinc in the United States in 1927 amounted to 592,516 short tons, a decrease of 4.2 per cent from 1926; production from domestic ores declined 5.7 per cent, whereas production from foreign ores increased. Decreased production of primary zinc was due to a drop of about 7 per cent in domestic consumption, which in turn was probably most seriously affected by recessions in automobile manufacture and industrial building activity. Notwithstanding the sharp decrease in production, stocks of zinc at smelters doubled during the year, 53,522 tons being reported on hand December 31, 1927. The curtailment of production was almost entirely in the output of the retort smelters of the Central States. There was a slight increase in the production of electrolytic zinc. World smelter production of zinc increased about 6 per cent.

Prices reacted to the unfavorable conditions resulting from decreased domestic consumption. The average quoted price for prime western zinc at St. Louis for 1927 was 6.25 cents per pound, compared with 7.37 cents for 1926. The steady decline in price that began in 1926 continued almost without interruption throughout 1927. The lowest monthly average in 1927 (5.73 cents) was that for December, whereas the highest for the year (6.71 cents) was that for March.

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[1] The statistics in this report were prepared (unless otherwise indicated) by H. M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

There was no material change in the quantity of zinc and zinc products imported and exported, except in exports of brass and bronze ("ingots, scrap, and old"), which increased more than 80 per cent. The zinc in ore imported decreased 35 per cent, and ore and concentrates exported decreased 51 per cent.

PRODUCTION

GENERAL

The production of slab zinc is classified by the Bureau of Mines as (1) primary or secondary, according to whether the zinc has been manufactured from primary or secondary materials; (2) domestic or foreign, a division of primary production based on whether the materials used were domestic or foreign; (3) electrolytic or distilled, based on the process of manufacture.

To determine the production of primary zinc, the Bureau of Mines makes a canvass of the zinc smelters that ordinarily operate on primary raw materials of domestic and foreign origin. Many of these smelters also include substantial amounts of secondary materials in their furnace charges, so the slab zinc produced includes both primary and secondary zinc. Although the two are inseparable, the smelter calculates the amount of zinc produced from the secondary materials and classifies it as redistilled secondary zinc. A similar calculation is made in order to separate primary zinc into zinc of domestic and foreign origin.

The following table shows the quantity and value of domestic primary, foreign primary, and redistilled secondary zinc produced in the United States during the last 10 years:

Distilled and electrolytic zinc produced in the United States, 1918–1927

Year	Domestic primary		Foreign primary		Redistilled secondary		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	492, 405	$89, 618, 000	25, 522	$4, 645, 000	9, 918	$1, 805, 000	527, 845	$96, 068, 000
1919	452, 272	66, 032, 000	13, 471	1, 967, 000	19, 748	2, 883, 000	485, 491	70, 882, 000
1920	450, 045	72, 907, 000	13, 332	2, 160, 000	21, 371	3, 462, 000	484, 748	78, 529, 000
1921	198, 232	19, 823, 000	2, 268	227, 000	17, 573	1, 757, 000	218, 073	21, 807, 000
1922	353, 274	40, 273, 000	1, 003	114, 000	32, 988	3, 761, 000	387, 265	44, 148, 000
1923	508, 335	69, 134, 000	2, 099	285, 000	39, 434	5, 363, 000	549, 868	74, 782, 000
1924	515, 831	67, 058, 000	1, 508	196, 000	35, 486	4, 613, 000	552, 825	71, 867, 000
1925	555, 631	84, 456, 000	17, 315	2, 632, 000	39, 181	5, 955, 000	612, 127	93, 043, 000
1926	611, 991	91, 799, 000	6, 431	964, 000	40, 799	6, 120, 000	659, 221	98, 883, 000
1927	576, 960	73, 851, 000	15, 556	1, 991, 000	42, 784	5, 476, 000	635, 300	81, 318, 000

PRIMARY ZINC

The term "primary zinc" as used herein refers only to zinc produced from ores or from the immediate by-products of primary smelting operations. Thus, zinc manufactured from smelter drosses and skimmings is designated as primary, whereas that produced from galvanizer's drosses, ashes, and scrap metal is designated as secondary. Although a large part of the latter enters the market indistinguishable from the former and becomes a part of the supply of zinc available to consumers, it is, nevertheless, deemed advisable to retain the above classification; otherwise the long-time record of production might include metal that is constantly reworked.

The following table shows the primary zinc produced in the United States from 1918 to 1927, apportioned according to the source of the ore and the locality at which reduced.

Primary zinc produced in the United States, 1918–1927, in short tons

APPORTIONED ACCORDING TO SOURCE OF ORE

Year	Domestic[1]	Foreign						Total
		Australia	Canada	Europe	Mexico	South America	Total	
1918	492, 405	1, 780	8, 700	113	14, 043	886	25, 522	517, 927
1919	452, 272	630	4, 007	----------	8, 083	751	13, 471	465, 743
1920	450, 045	2, 235	1, 583	----------	8, 978	536	13, 332	463, 377
1921	198, 232	133	521	----------	1, 614	----------	2, 268	200, 500
1922	353, 274	----------	55	----------	948	----------	1, 003	354, 277
1923	508, 335	----------	----------	----------	2, 099	----------	2, 099	510, 434
1924	515, 831	----------	1, 396	----------	112	----------	1, 508	517, 339
1925	555, 631	----------	7, 997	----------	9, 318	----------	17, 315	572, 946
1926	611, 991	----------	----------	----------	6, 431	----------	6. 431	618, 422
1927	576, 960	----------	----------	----------	15, 556	----------	15, 556	592, 516

APPORTIONED ACCORDING TO LOCALITY AT WHICH REDUCED

Year	Arkansas	Illinois	Kansas	Montana	Oklahoma	Pennsylvania	Other States	Total
1918	26, 753	141, 844	29, 149	35, 351	139. 066	77, 342	68, 422	517, 927
1919	31, 437	118, 458	43, 942	24, 255	121, 988	67. 521	58, 142	465, 743
1920	31, 481	109, 056	41, 044	50, 017	110, 500	74, 234	47, 045	463, 377
1921	15, 278	48, 865	16, 573	11, 559	41, 244	36, 378	30, 603	200, 500
1922	13, 627	76, 266	24, 167	55, 369	74, 537	57, 319	52, 992	354, 277
1923	29, 870	93, 239	32, 006	71, 088	119, 744	82, 003	82, 484	510. 434
1924	28, 447	93, 370	28, 640	77, 493	118, 487	83, 016	87, 886	517, 339
1925	27, 145	109, 672	25, 765	79, 004	138, 906	99, 899	92, 555	572, 946
1926	32, 712	110, 381	33, 671	111, 596	136, 560	100, 538	92, 964	618, 422
1927	26, 317	102, 768	33, 144	112, 629	120, 801	106, 099	90, 758	592, 516

[1] The slab zinc which was rolled is included here.

The steady increase in production that has persisted since 1921 was broken in 1927. Production of primary zinc from domestic ores decreased 35,031 tons, or 5.7 per cent, from 1926; production from foreign ores, all of Mexican origin, increased 9,125 tons, or 142 per cent; and the total production decreased 25,906 tons, or 4.2 per cent.

Oklahoma continued as the largest zinc-smelting State but showed a substantial decrease in output, as did Illinois and Arkansas. The decreased smelter production in these States may be attributed to the curtailment of mining operations in the tri-State district (Joplin region), due to low prices. The smelter production of Kansas decreased slightly. Montana continued to rank second as a reducer of zinc, and increased its output slightly. The smelter production of Pennsylvania, which has been increasing steadily since 1921, surpassed that of Illinois and was third in importance in 1927. Other States in which zinc-smelting plants were operating in 1927 were West Virginia, Texas, and Indiana, named in order of output. West Virginia showed a decrease of about 15 per cent in smelter output, whereas Texas and Indiana showed substantial increases.

DISTILLED AND ELECTROLYTIC ZINC

As already stated, a considerable quantity of material designated as secondary zinc results from redistillation of zinc ashes and scrap; some smelters that regularly handle ore may at times smelt a mixture of secondary material and ore. In marketing slab zinc so produced it is not distinguished from primary metal. For statistical purposes, however, the amount of this secondary metal is calculated by the smelters and is recorded herein as redistilled secondary zinc.

During the World War, when a large part of the zinc output was being purchased by the Government, it became customary to refer to zinc by grades A, B, C, and D, according to its composition. Since the war the trade has abandoned this terminology and has returned to the classification as high grade, intermediate, brass special, and prime western. In segregating production into the various grades the smelters report the total production and do not differentiate between primary distilled and redistilled secondary. The following table, however, shows the total production of electrolytic and distilled zinc, both primary and secondary, apportioned according to method of reduction and according to grade.

Distilled and electrolytic zinc, primary and secondary, produced in the United States 1918–1927, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic	Distilled primary	Redistilled secondary[1]	Total
1918	[2]38,916	[2]479,011	9,918	527,845
1919	27,056	438,687	19,748	485,491
1920	51,626	411,751	21,371	484,748
1921	11,559	188,941	17,573	218,073
1922	55,369	298,908	32,988	387,265
1923	71,088	439,346	39,434	549,868
1924	77,493	439,846	35,486	552,825
1925	79,004	493,942	39,181	612,127
1926	111,596	506,826	40,799	659,221
1927	112,629	479,887	42,784	635,300

APPORTIONED ACCORDING TO GRADE

Year	Grade A (high grade)	Grade B (intermediate)	Grade C (select and brass special)	Grade D (prime western)	Total
1918	129,344	68,987	98,584	230,930	527,845
1919	45,377	39,173	140,917	260,024	485,491
1920	80,713	33,893	59,811	310,331	484,748
1921	24,084	4,996	47,814	141,179	218,073
1922	67,459	36,402	49,980	233,424	387,265
1923	89,739	58,513	90,459	311,157	549,868
1924	108,238	48,874	100,290	295,423	552,825
1925	111,964	49,198	81,176	369,789	612,127
1926	143,224	48,169	84,689	383,139	659,221
1927	150,933	40,121	72,104	372,142	635,300

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[1] For total production of secondary zinc see p. 486.

[2] Figures for distilled primary include 753 tons of prime western zinc refined by electrolysis; quantity excluded from electrolytic.

The table shows that production of the lower grades of zinc decreased in 1927, while that of high grade increased. During the last few years the production of high-grade zinc has been increasing, although the average premium actually received for this product by the producer has shown a marked decrease. (See table on p. 507.) Both of these conditions have probably been due to the increasing production of electrolytic zinc, most of which is classified as high grade. In 1914, when no electrolytic zinc was produced, the production of high-grade zinc was only 5 per cent of the total output of distilled zinc, and a premium of about 3 cents a pound was paid. In 1922, when electrolytic zinc constituted about 14 per cent of the total output, the production of high-grade zinc amounted to 17 per cent of the total, and the average premium actually received by smelters had decreased to 0.4 cent per pound over prime western. In 1927 about 18 per cent of the total production was electrolytic zinc, nearly 24 per cent was high-grade zinc, and the average premium was 0.3 cent per pound. High-grade zinc is used in the manufacture of certain brasses and alloys and of sheet zinc.

The use of the intermediate grade of zinc is practically limited to specialty alloys and is becoming of less importance. In 1923 this grade represented 10.6 per cent of the total output, but in 1927 it had declined to 6.3 per cent. Brass special, as its name suggests, is largely used in the manufacture of brass. During the last few years the relative importance of this grade has decreased on account of the tendency of brass manufacturers to use increasing amounts of high-grade zinc. The premium on brass special ranged from approximately 0.04 cent to 0.10 cent during 1927. The production of prime western zinc during the past six years has amounted to 58 per cent of the total output of electrolytic and distilled zinc. The chief use of this grade is in the zinc-coating (galvanizing) industry.

ROLLED ZINC

The accompanying tables show the quantity and value of rolled zinc produced in the United States from 1918 to 1927. The total production in 1927 was 24,400,000 pounds, or 14 per cent less than that in 1926. The total value decreased over $4,200,000, or 23.5 per cent. The largest decrease (17.5 per cent) was in the production of sheet zinc of ordinary thickness. Production of strip and ribbon zinc decreased 14 per cent. Production of boiler plate and thick sheets increased nearly 70 per cent, but the output was only 2.8 per cent of the total production of rolled zinc in 1927.

Imports of rolled zinc in 1927, as in 1926, were negligible. Exports in 1927 amounted to more than 7,800,000 pounds, or 5 per cent of the total production. The 1926 exports represented about the same proportion of the production, so that the quantity of rolled zinc available for consumption in the United States in 1927 decreased in the same ratio as production—14 per cent.

Zinc rolled in the United States, 1918–1927

Year	Pounds	Value		Year	Pounds	Value	
		Total	Average			Total	Average
1918	139,773,825	$20,905,454	$0.150	1923	111,666,474	$10,164,981	$0.091
1919	108,593,747	11,447,569	.105	1924	122,064,719	11,552,354	.095
1920	106,467,530	12,290,233	.115	1925	142,263,945	14,514,234	.102
1921	60,800,186	5,940,208	.098	1926	172,668,298	17,880,901	.104
1922	107,018,690	8,546,109	.080	1927	148,259,718	13,671,530	.092

Rolled zinc available for consumption in the United States, 1926 and 1927

	1926			1927		
	Pounds	Value		Pounds	Value	
		Total	Average		Total	Average
Sheet zinc not over 0.1 inch thick	59,866,845	$6,478,927	$0.108	49,371,015	$4,713,995	$0.095
Boiler plate and sheets over 0.1 inch thick	2,469,614	239,215	.097	4,180,253	364,770	.087
Strip and ribbon zinc	110,331,839	11,162,759	.101	94,708,450	8,592,765	.091
Total zinc rolled	172,668,298	17,880,901	.104	148,259,718	13,671,530	.092
Sheet zinc imported for consumption	352	46	.131	1,901	271	.143
Rolled zinc exported	9,281,465	1,086,967	.117	7,844,757	869,425	.111
Available for consumption	163,387,185			140,416,862		
Slab zinc, grades B and C			.076			.065
Spread			.028			.027

The quoted base price of sheet zinc, f. o. b. rolling mills, ranged from 9¾ to 11 cents per pound during 1927; the closing quotation was 10 cents. These quotations, however, are subject to discounts, which may fluctuate, whereas the base quotations remain steady. The average price actually received by rolling mills reporting to the Bureau of Mines was 9.2 cents for all classes of rolled zinc, as compared with 10.4 cents in 1926. The average price of the grades of slab zinc used in the manufacture of rolled zinc was 6.5 cents in 1927, giving a premium of 2.7 cents for the rolled product. The spread in 1926 was 2.8 cents per pound.

The following companies reported production of rolled zinc in 1927:

Producers of rolled zinc in the United States in 1927

	Location of plant
American Zinc Products Co	Greencastle, Ind.
Ball Bros. Co	Muncie, Ind.
Edes Manufacturing Co	Plymouth, Mass.
Hazel-Atlas Glass Co	Wheeling, W. Va.
Hegeler Zinc Co	Danville, Ill.
Illinois Zinc Co	Peru, Ill.
Matthiessen & Hegeler Zinc Co	La Salle, Ill.
New Jersey Zinc Co	Palmerton, Pa.
The Platt Bros. & Co	Waterbury, Conn.

ZINC DUST

The commercial production of zinc dust in the United States began in 1910 and reached the maximum in 1920, when it amounted to approximately 11,500 tons. During the last five years production has averaged about 8,000 tons annually. The 1927 production showed no material change.

Zinc dust varies in composition but on the average contains about 90 per cent of metallic zinc and 10 per cent of zinc oxide, the latter occurring as a film on the surface of the metallic particles. Before 1926 two varieties of zinc dust—"blue powder" and "atomized"—were produced, the former by the distillation of zinc and the latter by ejecting molten metal under pressure from a nozzle. No atomized zinc dust was produced in 1926 or 1927.

The following table gives the annual production of zinc dust from 1918 to 1927:

Zinc dust sold by producers in the United States, 1918–1927

Year	Prepared "blue powder"			Zinc dust "atomized"			Primary zinc recovered as zinc dust (short tons)[1]
	Short tons	Value		Short tons	Value		
		Total	Average per pound		Total	Average per pound	
1918	4, 016	$877, 171	$0. 109	3, 139	$815, 346	$0. 130	4, 166
1919	4, 083	801, 366	. 098	2, 715	566, 294	. 104	3, 430
1920	9, 066	2, 009, 117	. 111	2, 463	555, 773	. 113	6, 425
1921	2, 006	333, 390	. 083	999	152, 151	. 076	1, 380
1922	3, 394	531, 225	. 078	3, 859	573, 220	. 074	2. 113
1923	3, 676	643, 766	. 088	4, 376	702, 923	. 080	2, 450
1924	3, 894	620, 078	. 080	4, 063	621, 221	. 076	1, 861
1925	[2]8, 314	[2]1, 500, 758	[2]. 090	(2)	(2)	(2)	2, 251
1926	7, 994	1, 490, 293	. 093				2, 794
1927	8, 098	1, 345, 105	. 083				3, 249

[1] The amount of secondary zinc recovered in zinc dust, 1924–1927, is shown in the table on secondary zinc, p. 486.

[2] Figures for "atomized" included under "blue powder." Bureau of Mines not at liberty to publish figures separately.

The following is a list of producers of zinc dust for the market in 1927:

Producers of zinc dust in the United States in 1927

	Location of plant
The Alloys Co	San Francisco, Calif.
John Finn Metals Works	Do.
Grasselli Chemical Co	Clarksburg, W. Va.
Do	Meadowbrook, W. Va.
New Jersey Zinc Co	Palmerton, Pa.
Superior Zinc Corporation	Philadelphia, Pa.
United States Zinc Co	Sand Springs, Okla.

The Superior Zinc Corporation and the Meadowbrook plant of the Grasselli Chemical Co. began production of zinc dust in 1927.

The average weekly high and low prices for zinc dust in 1927 were quoted by the Oil, Paint and Drug Reporter as 10¾ and 8⅞ cents, respectively.

The uses of zinc dust have been summarized by A. P. Cobb,[2] as follows:

> Zinc dust was originally obtained as a by-product gathered at the beginning of distillation, but it is now distilled in furnaces especially designed and operated for the sole production of metallic zinc powder. Originally zinc dust served only for the purpose of a gray paint destined to protect iron against oxidation, the earliest known reference to its use being in 1840, by R. Mallet, an Englishman. Since that time it frequently has been referred to in treatises on painting. At the present time zinc dust paints are used almost exclusively for plant painting in the industrial districts of France, Belgium, and Western Germany. It is also being used extensively in marine paints, both here and abroad. Sherardizing, dye-manufacturing, and cyaniding are also important outlets for zinc dust. Along an entirely different line, the United States Navy has found that a most effective smoke screen can be made by the use of zinc dust.

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[2] Cobb, A. P., Zinc in American Industry: Mining Cong. Jour., vol. 12, September, 1926, pp 643-645.

ZINC PIGMENTS AND SALTS

Zinc oxide, leaded zinc oxide, and lithopone are the principal pigments of zinc, and the chloride and sulphate are the principal salts. These products are manufactured from various zinciferous materials, classified as primary, secondary, and metallic zinc. The following table gives the zinc content of pigments and salts produced from primary materials, a large part of which was zinc ore. Some of the output was derived from primary drosses from zinc reduction works.

Primary zinc content of zinc pigments and salts made in the United States, 1918–1927, in short tons

Year	Pigments	Salts
1918	102,778	(1)
1919	96,817	3,393
1920	110,695	6,284
1921	53,480	3,749
1922	93,112	1,801
1923	115,970	1,573
1924	108,282	1,075
1925	110,554	673
1926	127,685	2,106
1927	121,899	47

[1] Figures not available.

SECONDARY ZINC

The accompanying table shows the amount of secondary zinc recovered in the United States as metal and in zinc dust, zinc pigments, and zinc salts, 1924 to 1927. The recovery of secondary zinc in the form of metal decreased less than one-half of 1 per cent, while production of primary zinc decreased 4.2 per cent. Remelted zinc decreased 7 per cent, redistilled zinc increased 5 per cent, and zinc in alloys (including brass) decreased 1 per cent. Further details of the recovery of secondary zinc are shown in the chapter of this series on secondary metals.

Secondary zinc recovered in the United States, 1924–1927, in short tons

	1924	1925	1926	1927
Secondary zinc, redistilled	35,486	39,181	40,799	42,784
Secondary zinc, remelted	23,400	22,249	23,771	22,016
Recovered zinc in alloys, excluding old brass remelted	10,500	13,300	13,430	12,400
Recovered zinc in remelted brass (estimated)	63,000	53,300	63,000	63,200
Secondary zinc recovered as metal	132,000	128,000	141,000	140,400
Secondary zinc recovered in zinc dust	5,093	5,232	4,400	4,400
Secondary zinc recovered in pigments	9,021	11,714	12,480	14,000
Secondary zinc recovered in zinc salts	10,225	10,928	10,084	9,544
Total secondary zinc	157,000	156,000	168,000	168,300

The increasing importance of the secondary metal industry is well evidenced by the number of articles relating to it that have appeared in the technical press in recent years. The exchange of information thus effected has promoted a tendency toward standardization so that to-day the scrap business is established on a more scientific basis than it was a few years ago. The organization of the scrap-metal industry has been summarized by A. B. Parsons,[3] as follows:

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[3] Parsons, A. B., How and Why Salvaged Scrap Affects Markets for Virgin Metals: Eng. and Min. Jour., vol. 125, Feb. 18, 1928, pp. 286–290.

The itinerant junk collector still exists; and he continues to be an important factor in the business. His function is to gather up material that has outlived its usefulness from the general public, the ultimate consumer of manufactured goods. He buys as cheaply as he can and sells for all he can get, sorting his material roughly and selling small lots, depending on casual inspection to ascertain the value. Next comes the small dealer or wholesaler. He buys from the junk man, sorts and classifies his metals and alloys, accumulates larger lots of different kinds, and sells to a larger dealer or trader, who may further classify and combine, selling finally in carload lots either to smelters or melters. The distinction is a nice one; the smelter mixes charges, uses fluxes, and usually makes a pure metal or an alloy of different composition from any of the materials he feeds to his furnaces. The melter simply fuses alloys or metals and casts pig or other shapes for resale; or he may be a manufacturer who buys good clean scrap to use in his own foundry.

A different channel through which old metal gets back into use is the salvage departments of the large industrial corporations. They reclaim thousands of tons of metals, some of which are used in the identical plant where they originate, some of which may be sent to the other plants controlled by the same company, and some of which may be sold either to the larger waste-metal dealers or to the smelters. The disposition depends naturally on the method that realizes the largest profit.

Recent years have been marked by a trend toward more careful sorting and classification on the part of the companies that "produce" the scrap, and the direct sale to "consumers" of scrap—namely, the smelting or foundry companies. The dealer who used to come to the plant and haul away a few truck loads of miscellaneous scrap is a less prominent part of the picture than he was, so far as the big sellers are concerned. It is important to bear in mind that the quantity of reclaimed metals supplied by the big manufacturing, railroad, motor car, public utility, and industrial companies does not by any means overshadow, in the aggregate, that supplied by the millions of households and small businesses.

In the upper strata, at least, the scrap-metal industry in recent years has made great progress in improving the character of its business dealings. The old basis of most transactions was caveat emptor—let the buyer beware. Profits in a measure depended on how cute the seller happened to be. Square dealing had no place in his business code. To-day conditions are greatly improved. Large "consumers" of scrap often—perhaps generally—buy on the basis of sampling and assay, just as ores are purchased. Incidentally, a highly specialized technique has been developed for the accurate sampling of dozens of classes of old materials that for one reason or other present serious difficulties. One other development is the increased use of more complex alloys of nonferrous metals. In addition to the major metals one finds chromium, molybdenum, tungsten, vanadium, sodium, and calcium in the present generation of alloys. This has complicated the technique of reclaiming.

The National Association of Waste Material Dealers has drawn up a set of standard specifications for old metals, classifying and defining in a rather broad way 36 kinds of scrap and waste products. It also has established rules regarding weights, delivery, and rejection, and provides for the settlement of disputes between members by an arbitration committee established by the association. It has been instrumental in developing business ethics that approach those of other industries.

From the standpoint of the miner and the primary metal producer the return of secondary zinc has a decidedly adverse effect on the market, but in this respect zinc is in a better position than other base metals. In 1926 the recovery of secondary zinc in the form of metal was 141,000 tons, and the production of primary zinc amounted to 618,422 tons—a ratio of 22.8 per cent. Similar ratios for copper and lead in 1926 were 41.3 per cent and 34.7 per cent, respectively. This relatively advantageous position of zinc is probably due to the large percentage consumed in dissipative uses, such as zinc coatings, zinc dust, pigments, and salts which yield little secondary metal. Of the total zinc content of ores available in the United States it is estimated that approximately 35 per cent is eventually available for secondary use. The other 65 per cent represents milling and metallurgical losses, amounting to about 15 to 20 per cent, and the balance is zinc going into dissipative uses. Beyond this there is the question of the efficiency of modern salvaging organization. The determination of what part of the available scrap is actually collected and returned to industry is a matter of speculation. Of all the zinc mined each year probably considerably less than 35 per cent is being returned for secondary use.

BY-PRODUCT SULPHURIC ACID

An important by-product of zinc-smelting operations is the sulphuric acid made from the sulphur gases evolved in roasting zinc sulphide ores preparatory to their distillation or conversion to zinc oxide or to zinc salts. Sulphur gases from zinc ores were first thus utilized, in the United States at least, by Matthiessen & Hegeler, at La Salle, Ill., in 1882, but now these gases are used at numerous acid plants. These plants may be at zinc smelters and zinc oxide plants, at roasting and magnetic separating plants, at the mines, or nearer the acid markets, the roasted concentrates being shipped to the smelters or to other zinc plants.

For several years the demand for sulphuric acid has been strong, and in order to utilize their acid-plant capacities producers have been forced to burn large quantities of sulphur to supplement the gases derived from the roasting of zinc blende. Thus, the acid production recorded as a by-product of zinc smelting has been derived from two sources—zinc ores and sulphur.

The following table gives the total quantity and value of sulphuric acid of different strengths produced and sold by plants associated with zinc-blende roasting operations:

By-product sulphuric acid produced at zinc-blende roasting plants in the United States, 1924–1927

	1924	1925	1926	1927
Number of establishments	22	22	22	22
Acid reported as 50°-60° B.:				
Produced (expressed as 60° B.) short tons	507, 208	616, 171	647, 380	605, 086
Consumed at works (expressed as 60° B.) do	32, 721	31, 902	37, 555	34, 586
Sold (expressed as 60° B.) do	464, 483	599, 729	615, 356	572, 347
Value of acid sold—				
Total	$4, 203, 619	$5, 175, 994	$5, 839, 666	$5, 588, 204
Average	$9. 05	$8. 63	$9. 49	$9. 76
Acid reported as 66° B. and stronger:				
Produced (expressed as 66° B.) short tons	354, 417	388, 699	401, 841	401, 290
Consumed at works (expressed as 66° B.) do	40, 484	46, 781	50, 412	48, 637
Sold (expressed as 66° B.) do	308, 951	369, 974	364, 706	334, 470
Value of acid sold—				
Total	$4, 248, 640	$4, 918, 716	$4, 935, 104	$4, 752, 736
Average	$13. 75	$13. 29	$13. 53	$14. 21
Total acid sold, equivalent in 60° B.:				
Quantity short tons	835, 225	1, 043, 697	1, 053, 003	973, 711
Value	$8, 452, 259	$10, 094, 710	$10, 774, 770	$10, 340, 940
Total acid consumed at works (60° B.) short tons	81, 302	88, 039	98, 049	92, 950

The total production of by-product sulphuric acid (60° B.) in 1927 amounted to 1,091,253 tons, a decrease of 4 per cent, as compared with 1926, and about 20 per cent of the total output of sulphuric acid in the United States as estimated by Chemical and Metallurgical Engineering.[4] The quantity of acid sold by zinc plants in 1927 decreased 7.5 per cent as compared with 1926, but as there was an increase in the average price the total value of the sales decreased only 4 per cent.

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[4] Chemical and Metallurgical Engineering: January, 1928, p. 59. Estimated production for 1927 was 6,935,000 tons of 50° B., equivalent to 5,557,000 tons of 60° B. acid.

The distribution of acid production according to sources, whether from zinc blende or sulphur, is based on calculation to some extent. Statistics on production by sources, therefore, do not agree exactly with the production as given in the foregoing table. The following statement shows the quantity of blende and sulphur used and the production and value of the acid made from each:

Production and value of sulphuric acid made from blende and sulphur at zinc-blende roasting plants in the United States in 1927

Number of establishments	22
Blende used short tons	626, 115
Acid made, equivalent in 60° B do	588, 544
Value at $9.76 per ton (average of sales of 60° B.)	$5, 744, 189
Sulphur used short tons	133, 088
Acid made, equivalent in 60° B do	502, 709
Value at $9.76 per ton (average of sales of 60° B.)	$4, 906, 440
Total quantity of acid made (60° B.) short tons	1, 091, 253
Total value of acid made	$10, 650, 629

A list of the operators and the location of acid plants whose outputs in the years 1924 to 1927 are shown in the preceding tables follows. Plants at zinc smelters are also indicated in the list of zinc-reduction plants given on page 491. The American Zinc Oxide Co., of Columbus, Ohio, has a zinc-roasting plant and disposes of the sulphur gases to the neighboring plant of the Farmers Fertilizer Co.

Producers of by-product sulphuric acid at zinc-blende roasting plants in the United States, 1924–1927

	Location of plant
American Steel & Wire Co	Donora, Pa.
American Zinc & Chemical Co	Langeloth, Pa.
America Zinc Co. of Illinois	East St. Louis, Ill.
Do	Hillsboro, Ill.
American Zinc Oxide Co	Columbus, Ohio.
Bertha Mineral Co	Tiltonsville, Ohio.
Eagle-Picher Lead Co	Hillsboro, Ill.
Grasselli Chemical Co	Grasselli, Ind.
Do	Canton, Ohio.
Do	Cleveland, Ohio.
Do	Lockland, Ohio.
Do	Niles, Ohio.
Do	New Castle, Pa.
Hegeler Zinc Co	Danville, Ill.
Illinois Zinc Co	Peru, Ill.
Matthiessen & Hegeler Zinc Co	La Salle, Ill.
Mineral Point Zinc Co	Depue, Ill.
Do	Mineral Point, Wis.
National Zinc Co	Argentine, Kans.
National Zinc Separating Co	Platteville, Wis.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
United Zinc Smelting Corporation	Moundsville, W. Va.

MINE PRODUCTION

The following table shows the mine production of recoverable zinc in the United States, by States, during the past 10 years.

Mine production of recoverable zinc in the United States, 1918–1927, in short tons

State	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Arizona	1, 135	859	729	--------	105	260	--------	3, 666	6, 473	1, 134
Arkansas	951	189	329	15	134	148	4	43	87	128
California	2, 781	236	583	423	1, 506	--------	1, 530	5, 745	10, 217	4, 031
Colorado	44, 567	18, 610	24, 395	1, 180	11, 629	27, 076	28, 364	30, 811	32, 500	35, 865
Idaho	22, 581	7, 997	13. 966	17	2, 055	13, 976	7, 670	15, 619	26, 307	26, 778
Illinois	3, 792	6, 788	4, 720	2, 426	3, 124	1, 266	2, 512	2, 724	2, 577	521
Kansas	30, 197	47, 636	61, 073	36, 991	56, 225	100, 969	105, 392	118, 778	126, 307	109, 427
Kentucky	315	36	9	220	142	270	492	429	1, 838	860
Missouri	55, 992	31, 540	24, 509	10, 845	16, 171	18, 265	12, 920	14, 794	26, 018	18, 737
Montana	104, 629	84, 382	92, 169	11, 638	59, 535	70, 730	64, 238	57, 658	73, 701	80, 231
Nevada	8, 362	4, 502	5, 349	35	1, 309	7, 083	5, 501	7. 411	5, 409	3, 172
New Hampshire	14	--------	--------	--------	--------	--------	--------	--------	--------	--------
New Jersey	102, 318	92, 516	78, 511	56, 447	73, 657	75, 227	84, 370	89, 261	80, 629	95, 695
New Mexico	12, 025	3, 797	5. 007	114	2, 248	8, 248	10, 380	9, 246	12, 052	29, 802
New York	3, 776	5, 120	5, 654	1, 572	4, 816	8, 463	4, 664	5, 158	5, 041	3, 750
Oklahoma	161, 401	178, 410	219, 727	121, 372	209, 682	242, 421	269, 137	283, 371	272, 567	206, 611
Tennessee	21, 071	23, 247	19, 217	9, 692	15, 568	15, 900	14, 376	16, 256	12, 098	10, 400
Utah	9, 200	2, 216	4, 079	35	2, 560	5, 665	9, 281	26, 306	47, 590	49, 593
Virginia	951	--------	--------	--------	--------	--------	2, 664	2, 732	5, 830	8, 325
Washington	19	--------	213	225	614	1, 512	455	609	522	640
Wisconsin	50, 014	40, 765	27, 285	3, 390	10, 952	13, 211	14, 027	20, 230	26, 800	32, 841
	636, 091	548, 846	587, 524	256, 640	472, 032	610, 690	637, 977	710, 847	774, 563	718, 541

The mine production of zinc in 1927 was 7 per cent less than in 1926, while the production of primary zinc from domestic and foreign ores was only 4 per cent less. The outstanding point of interest in this decreased output was the large curtailment of mining in the tri-State district. In 1926 this district (Kansas, Oklahoma, and southwestern Missouri) produced 424,000 tons of recoverable zinc, or 55 per cent of the total mine production, whereas in 1927 it produced only 331,000 tons, or 46 per cent of the total. The decrease of 93,000 tons in the district output not only accounted for the decrease of 56,000 tons in total mine output but also offset an increase of 37,000 tons in the combined output of the other districts. Notwithstanding this marked curtailment of mine output, the stocks of ore in the tri-State district increased materially. Otto Ruhl, consulting mining engineer of Joplin, Mo., summarized the situation in the tri-State district as follows:[5]

> The reserve stocks of ore rose from 9,000 tons at the beginning of the year to 50,000 tons, with comparative regularity from month to month. Adding the shipments and stocks for showing the actual production of the field shows 739,145 for 1927 as compared with 849,758 tons in 1926. Curtailment of production, therefore, in the tri-State district actually totaled 110,613 tons of ore, or equivalent almost exactly of the amount of decrease in the metal production of the United States.
>
> Only a casual study of these statistics answers the question—At what price for zinc concentrates will production decline and stocks accumulate in the tri-State district? That point seems to be $40.00 to $45.00. On the other hand, the Eastern and Western States as a whole increased their output. Hence, it is apparent that the tri-State district is facing a condition of competition with other parts of the United States which is decidedly uncomfortable, and little relief is promised except through an unusually heavy demand from new consumption.

Outside of the tri-State district there was an increase in mine production. New Mexico recorded an increase of 18,000 tons or nearly 150 per cent, due to the beginning of operations at the Pecos mine in the northern part of the State. New Jersey, with a production of 96,000 tons, recorded the second largest increase, or 19 per cent over 1926, and was the largest producer outside the tri-State district. Montana followed, with an output of 80,000 tons, an increase of 9 per cent over 1926. Utah, Colorado, Wisconsin, and New Mexico were next in order of output; all recorded increases in production. Outside the tri-State district California showed the largest decrease; the State produced only 4,000 tons in 1927, as compared with 10,200 tons in 1926. Production in Tennessee decreased from 12,100 to 10,400 tons. Production decreased in varying degree in most of the other less important States.

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[5] Excerpt from address delivered at the tenth annual convention of the American Zinc Institute.

ZINC-REDUCTION PLANTS

ZINC SMELTERS

Twenty-four smelters containing 118,458 retorts were active some time during 1927, compared with 25 plants containing 122,404 retorts active in 1926. Three plants shut down during the year, so that by December 31, 1927, only 21 plants, using 77,388 retorts, were operating. On December 31, 1926, 24 plants, using 89,496 retorts, were operating. The United States Zinc Co's. plant at Kusa, Okla., was shut down in July, 1927, and has since been abandoned. The Clarksburg plant of the Grasselli Chemical Co. and the plant of the Falcon Zinc Co. operated part of the year but were idle on December 31, 1927.

During the year 800 retorts were added to the Amarillo plant of the United States Zinc Co. The Edgar Zinc Co. reported 60 new retorts under construction at their Cherryvale plant at the end of the year.

The following table shows the zinc-smelting plants operating in the United States in 1927:

Zinc-smelting plants operating in the United States in 1927

Operating company (A=acid plant located at the smelter)	Location of plant	Retorts
ARKANSAS		
Athletic Mining & Smelting Co.	Fort Smith	3, 328
Falcon Zinc Co.	Van Buren	3, 200
ILLINOIS		
American Zinc Co. of Illinois (A)	East St. Louis	5, 720
Hegeler Zinc Co. (A)	Danville	5, 400
Illinois Zinc Co. (A)	Peru	4, 400
Matthiessen & Hegeler Zinc Co. (A)	La Salle	6, 132
Mineral Point Zinc Co. (A)	Depue	9, 068
Missouri Zinc Co.	Beckemeyer	384
INDIANA		
Grasselli Chemical Co.	Terre Haute	4, 200
KANSAS		
Edgar Zinc Co.	Cherryvale	5, 100
Weir Smelting Co.	Caney	1, 920
OKLAHOMA		
Blackwell Zinc Co. (Inc.)	Blackwell	9, 600
Eagle-Picher Lead Co.	Henryetta	4, 800
National Zinc Co.	Bartlesville	4, 256
Quinton Spelter Co.	Quinton	3, 360
United States Zinc Co.	Henryetta	3, 200
Do	Kusa	3, 040
PENNSYLVANIA		
American Steel & Wire Co. (A)	Donora	7, 958
American Zinc & Chemical Co. (A)	Langeloth	4, 864
New Jersey Zinc Co. (of Pennsylvania) (A)	Palmerton	7, 200
TEXAS		
United States Zinc Co.	Amarillo	4, 800
WEST VIRGINIA		
Grasselli Chemical Co.	Clarksburg	5, 760
Do	Meadowbrook	8, 400
United Zinc Smelting Corporation (A)	Moundsville	2, 368
		118, 458

In addition to these smelters the following operators treated secondary materials in large graphite retorts in 1927:

Birmingham Smelting & Refining Co., Birmingham, Ala.
General Smelting Co., Philadelphia, Pa.
Superior Zinc Corporation, Philadelphia, Pa.
Tottenville Copper Co., Tottenville, N. Y.
Trenton Smelting & Refining Branch of Federated Metals Corporation, Trenton, N. J.
Wheeling Steel Corporation, Wheeling, W. Va.

The Birmingham Smelting & Refining Co. began operations early in the year.

ELECTROLYTIC PLANTS

The Great Falls plant of the Anaconda Copper Mining Co. (maximum daily capacity, 350 short tons of cathode zinc) operated continuously throughout the year. Construction of the company's new 150-ton plant at Anaconda, Mont., was practically completed during the year; production began in January, 1928. The Sullivan Mining Co. at Kellogg, Idaho, also started construction of an electrolytic zinc plant during 1927. The daily capacity of the plant will be 60 tons of cathode zinc. Production is expected the latter part of 1928. The company contemplates an ultimate capacity of 175 tons.

DEVELOPMENTS IN UNITED STATES ZINC INDUSTRY

FLOTATION

The application of selective flotation to the complex zinc-lead ores of the Rocky Mountain region has created a marked effect on the geographical distribution of ore supply in the United States. Although for several years before the World War flotation had been applied to considerable tonnages of the less complex zinc ores of the Western States, only within the last few years have large tonnages of flotation concentrates been produced in the West. This rapid increase is well illustrated by the following table, which shows production of zinc flotation concentrates in the United States, exclusive of the tri-State district, 1921 to 1927. It is said that by far the major part of this production is ascribable to the region west of the Rocky Mountains.

Zinc flotation concentrates produced in the United States, exclusive of the tri-State district, 1921–1927 [1]

Year	Concentrates (short tons)	Zinc content		Lead content	
		Short tons	Tenor, per cent	Short tons	Tenor, per cent
1921	38,433	15,311	39.84	4,457	11.60
1922	82,121	37,116	45.20	6,105	7.43
1923	169,496	83,778	49.42	11,181	6.60
1924	227,955	109,005	47.82	14,368	6.30
1925	253,989	130,594	51.42	11,064	4.36
1926	404,485	208,834	51.63	16,722	4.13
1927	499,706	265,146	53.06	12,293	2.46

[1] Year Book, American Bureau of Metal Statistics, 1927.

The foregoing table shows that during the last seven years the quantity of zinc flotation concentrates produced increased thirteenfold and the zinc content seventeenfold. This increase, however, is exaggerated, as production in 1921 and 1922 was below average, due to curtailment during that period. By 1923 production had resumed a normal trend, and a more accurate comparison can be made from then on. During the five years 1923 to 1927 the quantity of zinc flotation concentrates has increased steadily and in 1927 was nearly three times as much as in 1923, while the zinc content was more than three times that of 1923. In 1923 nearly 170,000 tons of zinc concentrates were produced, with an estimated recoverable zinc content of 69,000 tons, or 11 per cent of the total estimated recoverable zinc in ore mined in the United States in that year. In 1927 half a million tons of zinc flotation concentrates were produced, with a recoverable zinc content of 219,000 tons, or 30 per cent of the total mine output.

As already stated, most of this increase has resulted from the introduction of selective flotation into the Western States, and as a result this section has gained in importance as a source of zinc-bearing ores, largely at the expense of the tri-State district. In 1923 the tri-State district produced 59 per cent of the United States total mine output of zinc; the Western States, 22 per cent; and other States (mostly New Jersey), 19 per cent. In 1926 the tri-State district produced 55 per cent of the total; the Western States, 28 per cent; and the other States, 17 per cent. In 1927 the contrast was greater because of curtailment of mining in the tri-State district, although the combined output of other districts increased. The distribution of mine production of zinc in 1927 was as follows: Tri-State district, 46 per cent; Western States, 32; and other States, 22.

Flotation has also played an important part in increasing zinc production in the tri-State district, although the process was not introduced there until 1923. During 1923 and 1924 the output of flotation concentrates was comparatively insignificant. In 1925 and 1926 zinc production increased rapidly, because flotation was applied to the re-treating of the old tailings piles of the district. According to some estimates, 20 per cent of the 1927 zinc output of the tri-State district was derived from flotation concentrates. This output added to the production of the other districts indicates that about 40 per cent of the 1927 mine production of recoverable zinc in the United States was in the form of flotation concentrates, whereas the corresponding ratio in 1923 was only about 11 per cent.

Important developments in the flotation process during the last several years have been the production of higher grade concentrates and the marked decrease in the lead content of the concentrates. These factors are shown in the table given on page 492.

ZINC SMELTING

The rapidly increasing amounts of flotation concentrates produced in the United States have had an important effect on the zinc-smelting industry. Concerning this situation W. R. Ingalls[6] states:

> The metallurgy of zinc has been experiencing something like a revolution during the last two years, although we must not be too specific in respect to time, metallurgical changes always being gradual. The change in zinc metallurgy that is now in process is partly ascribable to the pressure of competition in an overbuilt industry and partly to the general introduction of the new process of

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[6] Ingalls, W. R., Pyrometallurgy-zinc: Eng. and Min. Jour., vol. 125, Jan. 21, 1928, p. 124.

selective flotation for the beneficiation of lead-zinc and lead-zinc-iron ores. This process was introduced in 1921, but for two or three years it did not attract general attention. With its aid almost any ore of this character that had previously been considered as rebellious became amenable to beneficiation. About 1925 there was an expeditious application of this process in many places.

The flotation concentrate comes to the smelter in the form of a sticky mud, which when dry becomes a fine-grained dusty material more or less of the physical nature of wheat flour. With their previously existing arrangements, smelters were not equipped easily to handle either the mud or the flour. The former condition introduced physical difficulties; the latter entailed serious loss of ore by dusting.

Previous to 1927 the smelters worked off this new material in conjunction with their previously normal ore and so carried it through their process with reasonably fair results. The treatment of such material occurred mainly in Oklahoma where the roasting is done on single-hearth furnaces, the dusting from which is naturally least. With the beginning of 1927 the supply of flotation concentrate had so increased that some smelteries had to be put upon an all-flotation basis, and the difficulties then became emphatic, especially if the roasting had to be done in multiple-hearth furnaces and in connection with the manufacture of sulphuric acid as a by-product.

These difficulties are by no means insuperable, and in the end it will be found that it has been an economic blessing that metallurgists were constrained to face. The trouble has been that smelters, having previously refused to modernize their plants and practices, became finally constrained to do so. Obviously this necessitates large capital expenditures.

The modernization of plants in America is taking the form of the substitution of roasting furnaces of the Ingalls-McDougall type, not trying to roast completely in them but finishing the desulphurization by sintering on Dwight-Lloyd machines and collecting the dust raised in the preroasting by means of a Cottrell electrical precipitation plant.

ELECTROLYTIC ZINC

Production of electrolytic zinc on a large scale began in 1916 at the Great Falls plant of the Anaconda Copper Mining Co. In that year the output was 11,000 tons, or 1.7 per cent of the total production of primary zinc in the United States. Since 1916 production of electrolytic zinc has increased rapidly each year, with the exception of 1919 and 1921, and in 1926 the output was nearly 112,000 tons, or 18 per cent of the total primary zinc. In 1927 depressed market conditions brought about a curtailment of retort smelter production, but the output of electrolytic zinc increased slightly and represented 19 per cent of the total output of primary zinc.

It is apparent from these figures that the expansion of the electrolytic process has hindered the progress of the retort-smelting industry. Many reasons have been advanced in explanation. Some claim that electrolytic plants are equipped to handle flotation concentrates more economically, and that the reduction works are located in a more advantageous geographic position with respect to sources of western flotation concentrates. Others claim that higher recoveries are made in the electrolytic process, and that a higher grade of slab zinc is produced. On the other hand, some state that with respect to costs the retort smelter has the advantage. In any event the facts are that electrolytic production has increased slightly in 1927 in spite of declining prices for zinc, whereas retort smelters have curtailed production materially.

Prospects for the future seem to indicate that the electrolytic process is destined for an even more important rôle. By the end of 1928 plants having a daily capacity of 560 tons of cathode zinc will be in operation. The Anaconda Copper Mining Co. has two plants—a 350-ton plant at Great Falls and a 150-ton plant at Anaconda, Mont. The Sullivan Mining Co. will operate a 60-ton plant at Kellogg, Idaho, and contemplates an ultimate daily capacity of 175 tons. The Evans-Wallower Lead Co. has announced plans for the construction of a 50-ton plant at East St. Louis, Ill. When completed, these plants will have a combined daily capacity of 725 tons, or about 40 per cent of the average daily output of primary zinc in 1926 and 1927.

WORLD SMELTER PRODUCTION

The following table shows the world smelter production of zinc from 1923 to 1927, so far as statistics are available. Official figures are used wherever possible. For countries for which official data are not yet available the figures are taken from the Year Book of the American Bureau of Metal Statistics and other reliable sources, but the official statistics will be substituted as received.

There is always a possibility of duplication in figures showing European production, as some countries send crude zinc of poor quality to other countries for refining. Furthermore, secondary zinc probably is included in figures of production reported by some foreign countries. The figures for such countries are therefore not fully comparable with the figures for production of primary zinc in the United States as given in the following table:

World smelter production of zinc, 1923–1927, in metric tons, by countries where smelted

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923	1924	1925	1926	1927
Australia: Tasmania	41,814	47,423	46,431	47,972	50,361
Belgium	147,040	161,700	170,860	188,767	199,090
Canada	27,238	24,896	34,892	55,998	66,413
China	508	203	305	300	(1)
Czechoslovakia	2,197	6,897	3,042	2,789	6,324
France	49,334	57,712	64,256	64,188	82,650
Germany	34,945	40,910	62,494	73,716	84,102
Great Britain	31,782	39,098	38,761	18,278	42,541
Indo-China	----------	72	1,158	1,858	1,170
Italy	3,681	5,959	6,478	7,636	7,367
Japan	13,780	14,069	16,950	16,972	17,558
Mexico	145	(1)	134	5,942	6,431
Netherlands	16,440	18,190	21,117	24,796	26,268
Norway	3,783	5,024	6,807	5,359	5,488
Poland	96,404	93,037	114,339	123,741	150,375
Rhodesia, Northern	----------	----------	240	240	----------
Russia [2]	187	517	1,492	1,888	2,330
Spain	10,922	12,777	15,122	16,065	16,531
Sweden	1,214	3,451	4,672	4,766	4,647
United States	463,056	469,320	519,765	561,020	537,519
Yugoslavia	1,947	2,126	2,075	2,376	3,185
Known production	946,000	1,003,000	1,131,000	1,225,000	1,310,000

[1] Data not available.

[2] Data for operating year ended Sept. 30.

For the first time in several years the zinc production of the United States decreased, while the production of the world increased. The decrease in the United States was due, primarily, to a sharp decrease in the domestic consumption of zinc in 1927; the recovery of the zinc industry of Europe during the last few years has also been a contributing factor. In 1926 exports of slab zinc from the United States decreased nearly 33,500 short tons, or 44 per cent, from 1925. Exports in 1927 increased moderately over 1926, but the foreign market for domestic zinc was still considerably under that of 1924 and 1925.

During the last few years the increase in production of zinc has been marked in Poland, Germany, France, Belgium, and Canada. An interesting comparison of the years 1924 and 1927 is given in the following table, which shows the output of the important producing countries and the ratio of each to the total world output.

World smelter production of zinc, 1924 and 1927, by countries where smelted

	1924		1927	
	Metric tons	Per cent of total	Metric tons	Per cent of total
United States	469,320	46.77	537,519	41.02
Europe:				
Belgium	161,700	16.11	199,090	15.19
Poland	93,037	9.27	150,375	11.48
Germany	40,910	4.08	84,102	6.42
France	57,712	5.75	82,650	6.31
Great Britain	39,098	3.90	42,541	3.25
Other Europe	54,941	5.48	72,140	5.50
Canada	24,896	2.48	66,413	5.07
Australia	47,423	4.73	50,361	3.84
Other countries	14,344	1.43	25,159	1.92
	1,003,000	100.00	1,310,000	100.00

The smelting of zinc began in the United States in 1858 and steadily increased in importance. In 1909 the United States became the largest producer of zinc in the world, with an output of 232,000 metric tons, or 30 per cent of the world total. The demoralization of the European zinc industry resulting from the World War gave further impetus to the rapidly expanding production of the United States, resulting in the tremendous production of 607,000 metric tons in 1917, or more than 61 per cent of the world total. Immediately following the war there was a general decrease in production throughout the world, especially marked in the United States in 1921, when production declined to only 38 per cent of the world total. Thereafter the industrial recovery of Europe and the simultaneous expansion of consuming industries in the United States created a world demand for zinc that exceeded all previous years. Increases in the production of the United States and many European countries followed. Expansion in Poland and Germany was hampered by political problems involved in the transfer of the Upper Silesian district. By 1923 the United States had regained part of its war-time prestige and produced in that year 49 per cent of the world total. Since then, however, largely because of increases in Poland and Germany, Europe has surpassed the United States, whose production in 1927 had fallen to about 41 per cent of the world total.

WORLD MINE PRODUCTION

The compilation of the world mine production of zinc is at best a difficult task, owing to the complete lack of published data for some countries and to lack of uniformity in reporting among the countries that do publish production data. The following table, compiled from official and semiofficial sources, is submitted as a partial record of the world mine production during the last five years. Supplementary data, based in part on estimates, are given in the yearbooks of the American Bureau of Metal Statistics and the Metallgesellschaft.

World mine production of zinc ore and concentrates, with estimated zinc content, 1923–1927, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1923		1924		1925		1926		1927	
	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content
North America:										
Canada	(1)	[2]27, 404	(1)	[2]44, 864	(1)	[2]49, 563	(1)	[2]68, 010	(1)	[2]74, 210
Mexico	41, 819	18, 481	58, 599	24, 659	120, 120	51, 795	(1)	105, 367	284, 558	137, 724
United States (recoverable zinc)	(1)	554, 006	(1)	578, 760	(1)	644, 866	(1)	702, 668	(1)	651, 846
South America:										
Bolivia (exports)	390	(1)	485	(1)	6, 210	2, 750	17, 560	7, 937	12, 889	5, 900
Chile—										
Zinc ore	--------	--------	--------	--------	--------	--------	1, 257	439	2, 360	940
Zinc-lead ore	--------	--------	--------	--------	--------	--------	58	15	222	63
Peru	--------	--------	(1)	145	(1)	14, 418	(1)	22, 975	(1)	17, 950
Europe:										
Austria [3]	1, 168	472	1, 227	488	1, 892	777	2, 305	889	3, 855	1, 563
Belgium	36	(1)	850	(1)	10, 201	(1)	12, 461	(1)	14, 090	(1)
Bulgaria	(1)	(1)	(1)	(1)	--------	--------	425	(1)	1, 495	(1)
Czechoslovakia	25	(1)	690	(1)	1, 057	(1)	540	(1)	856	(1)
Finland	--------	--------	--------	--------	--------	--------	1, 714	638	2, 968	1, 189
France	10, 940	5, 000	15, 072	7, 000	14, 765	6, 600	18, 800	(1)	15, 400	(1)
Germany [4]	77, 691	31, 782	102, 513	41, 667	122, 208	49, 121	201, 494	79, 393	260, 112	111, 440
Great Britain	2, 158	950	2, 354	826	1, 629	572	1, 975	854	2, 958	1, 272
Greece—										
Zinc ore	4, 026	1, 038	4, 861	1, 191	7, 594	1, 957	34, 751	6, 000	30, 597	5, 564
Zinc-lead ore	314	31	81	9	614	61	--------	--------	4, 452	445
Italy [5]—										
Zinc ore	132, 596	52, 455	151, 473	58, 302	177, 085	68, 886	177, 932	70, 675	222, 085	84, 836
Zinc-lead ore	1, 711	400	855	168	1, 883	426	20, 061	4, 028	2, 111	274
Norway	2, 226	882	1, 389	633	853	327	165	32	333	108
Poland	260, 039	(1)	237, 867	(1)	375, 313	(1)	405, 007	(1)	337, 874	(1)
Portugal	22	11	40	(1)	65	33	[6]236	106	382	153
Russia [7]—										
Zinc ore	275	(1)	2, 676	(1)	3, 430	(1)	913	(1)	(1)	(1)
Zinc-lead ore	731	(1)	7, 400	(1)	23, 091	(1)	32, 082	(1)	(1)	(1)
Spain	102, 313	38, 050	116, 721	41, 921	167, 939	48, 816	201, 335	58, 829	132, 178	47, 057
Spitzbergen	--------	--------	--------	--------	236	153	145	90	(1)	(1)
Sweden	41, 912	15, 719	47, 691	17, 139	51, 183	18, 636	56, 267	21, 307	62, 526	24, 372
Yugoslavia	618	(1)	549	(1)	535	(1)	581	(1)	1, 067	(1)
Asia:										
China (exports)	61, 064	(1)	20, 456	(1)	37, 747	(1)	24, 791	(1)	5, 388	(1)
Chosen	--------	--------	1, 051	(1)	3, 579	(1)	7, 102	(1)	3, 684	(1)
India (British)	[8]2, 095	974	18, 949	8, 408	17, 080	7, 750	49, 618	23, 048	59, 221	27, 508
Indo-China	30, 500	12, 800	42, 451	17, 829	52, 869	20, 792	62, 051	25, 053	55, 060	21, 800
Japan	24, 876	(1)	23, 317	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Russia [7]—Zinc-lead ore	--------	--------	--------	--------	345	(1)	2, 204	(1)	(1)	(1)
Africa:										
Algeria—										
Zinc ore	48, 015	19, 686	42, 759	17, 831	56, 181	22, 472	62, 154	27, 933	47, 830	21, 490
Zinc-lead ore	1, 316	526	--------	--------	575	230	473	99	110	23
Morocco, French	--------	--------	--------	--------	--------	--------	99	(1)	184	(1)
Rhodesia, Northern	73	(1)	--------	--------	6, 298	(1)	453	(1)	--------	--------
Tunisia—										
Zinc ore	12, 000	4, 800	14, 811	5, 200	22, 000	7, 590	30, 000	9, 000	18, 000	6, 300
Zinc-lead ore	--------	--------	--------	--------	9, 000	1, 395	7, 000	1, 155	9, 000	1, 485
Oceania:										
Australia [9]—										
New South Wales	432, 887	195, 000	359, 326	162, 000	230, 161	108, 000	271, 827	111, 000	281, 878	134, 000
Queensland	(1)	(1)	(1)	130	(1)	173	[6]563	203	--------	--------
New Caledonia	--------	--------	--------	--------	2, 000	620	2, 200	638	1, 500	450

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[1] Data not available.

[2] Estimated smelter recoveries.

[3] Data relate only to zinc concentrates; lead-zinc ores and concentrates not included.

[4] Data relate to concentrates produced and ore sold without concentration.

[5] In addition to the zinc and zinc-lead ores shown, Italy reported the following production of lead-zinc ore: 1924, 4,134 tons, average content not stated; 1925, 3,512 tons, average content, Pb. 16.12 per cent, Zn. 9.43 per cent; 1927, 3,753 tons, average content, Pb. 28 per cent, Zn. 7.54 per cent.

[6] Exclusive of 304 tons of zinc-lead ore, the content of which is not stated.

[7] Year ended Sept. 30.

[8] Exports.

[9] In addition to the States listed, Tasmania also produced zinc ore in 1924 and subsequent years, but figures of production are not available.

Before the introduction of the electrolytic process coal, clay, and skilled labor, as well as supplies of zinc ores, were essential to economical smelting operations. As a result the smelting of zinc outside of the United States became localized to a large extent in northwestern Europe, where the industry was first developed and where all of these essentials were plentiful. As the local deposits of zinc ore became exhausted, supplies were drawn from all the mining districts of the world. Thus, Belgium became the largest importer of zinc ores in the world. For many years she has been the second largest producer of slab zinc and yet her mines yield less than 1 per cent of the world total.

The United States produces about 45 per cent of the world mine output. Mexico and Australia ranked second and third with about 10 per cent each of the total mine output in 1927; but Australia produced only about 4 per cent of the smelter output and Mexico less than 1 per cent. Poland is an important zinc-mining country and smelts its own ore. Italy, Spain, Algeria, Indo-China, India (Burma), Peru, and Sweden are important producers of zinc ore but produce comparatively little or no metal.

IMPORTS

Zinc ore, imports of which decreased 35 per cent in total zinc content in 1927, is the chief zinc import of the United States. The ore imported contained 9,513 tons of zinc; virtually all of it came from Mexico and most of it was entered for warehouse. Withdrawals from warehouse exceeded the importations, so that the zinc (mostly in the form of ore) remaining in warehouse on December 31, 1927, was less than half that at the end of 1926. The value of zinc manufactures imported for consumption doubled in 1927, and imports of old brass decreased 7 per cent. Imports of other zinc commodities were negligible.

Zinc remaining in warehouse in the United States, December 31, 1918–1927

Year	Ore and calamine		Blocks, pigs, and old		Zinc dust	
	Zinc content (pounds)	Value	Pounds	Value	Pounds	Value
1918	53,766,247	$1,089,560				
1919	37,696,007	674,384				
1920	51,299,109	996,386				
1921	28,583,018	647,654	262,221	$10,911		
1922			160,976	6,396		
1923	1,736,874	84,977	160,976	6,396	[1]2,048	[1]$256
1924	12,103,110	494,605			[1]998	[1]38
1925	40,938,685	1,936,332				
1926	27,580,974	1,331,318				
1927	12,287,028	592,206				

[1] Includes manufactures of zinc.

Zinc ore imported into the United States, 1918–1927, in short tons

[General imports]

Year	Canada		Mexico		Other countries		Total	
	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content
1918	14, 987	5, 173	53, 348	18, 426	2, 567	1, 210	70, 902	24, 809
1919	10, 656	3, 878	33, 443	11, 225	4, 550	1, 906	48, 649	17, 009
1920	4, 731	1, 794	47, 453	14, 975	13, 589	5, 718	65, 773	22, 487
1921	1, 471	554	6, 050	2, 147	18	4	7, 539	2, 705
1922	(1)	235	(1)	1, 665	(1)	29	(1)	1, 929
1923	(1)	4	(1)	3, 201	(1)	18	(1)	3, 223
1924	--------	--------	(1)	4, 649	--------	--------	(1)	4, 649
1925	(1)	3, 894	(1)	9, 607	(1)	35	(1)	13, 536
1926	(1)	2, 281	(1)	12, 265	(1)	21	(1)	14, 567
1927	(1)	217	(1)	9, 285	(1)	11	(1)	9, 513

[1] Gross weight not recorded.

Zinc imported for consumption in the United States, 1918–1927

Year	Blocks or pigs		Sheets		Old		Zinc dust		Value of manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1918	11	$2, 897	(1)	$29	24	$2, 056	16	$3, 552	$331	$8, 865
1919	32	2, 284	1	249	37	2, 216	52	5, 753	1, 258	11, 760
1920	(1)	17	4	614	14	1, 065	17	6, 207	1, 746	9, 649
1921	6, 598	559, 870	6, 688	496, 445	6	341	42	1, 121	8, 290	1, 066, 067
1922	40	3, 327	416	59, 037	46	2, 403	79	5, 614	9, 517	79, 898
1923	1	375	(1)	41	20	1, 624	4	891	16, 331	19, 262
1924	11	1, 973	(1)	88	14	1, 493	59	9, 241	20, 089	32, 884
1925	(1)	303	(1)	55	24	2, 495	116	20, 936	18, 979	42, 768
1926	(1)	195	(1)	46	21	1, 315	2	451	44, 574	46, 581
1927	39	5, 089	1	271	19	1, 443	(1)	114	91, 519	98, 436

[1] Less than 1 ton.

Old brass fit only for remanufacture imported into the United States, 1918–1927

[General imports; average composition about one-third zinc and two-thirds copper]

Year	Short tons	Value	Year	Short tons	Value
1918	6, 115	$1, 774, 002	1923	20, 395	$3, 992, 917
1919	7, 938	2, 157, 948	1924	4, 636	698, 022
1920	22, 355	5, 174, 885	1925	5, 374	772, 906
1921	20, 449	2, 373, 082	1926	4, 311	631, 973
1922	71, 962	10, 985, 308	1927	3, 993	556, 064

EXPORTS

The total value of the 1927 exports of zinc ore and domestic manufactures of zinc (not including galvanized products, alloys, and pigments) was about $9,000,000, representing decreases of about 30 per cent from 1926 and about 50 per cent from 1925.

For many years slab zinc has been the largest single item of zinc exports. In 1927, 45,695 tons was exported, an increase of 6 per cent over 1926 but only 60 per cent of the slab zinc exported in 1925. The decrease since 1925 has undoubtedly been due to increased production in Europe and to the inability of American producers to compete in European markets under the low price of zinc prevailing in 1927. In 1925 Europe took 93 per cent of the total slab zinc exported from the United States, whereas in 1927 she took only 67 per cent. Shipments to the United Kingdom in 1927 increased 29 per cent over 1926 and represented two-thirds of the total export to Europe. Stabilized labor conditions contributed to the recovery of the zinc-consuming industries in England in 1927. Exports of slab zinc to South America increased from about 2,000 tons in both 1925 and 1926 to over 5,000 tons in 1927, Argentina taking about 80 per cent of the total in 1927. Exports in 1927 to Japan, second to the United Kingdom in consumption of American slab zinc, decreased 10 per cent from 1926.

Exports of zinc ore were second in importance to slab zinc. For several years prior to 1925 exports of zinc ores seldom exceeded 2,000 tons, but in 1925 the amount increased to 68,951 tons and in 1926 to 95,252 tons. The tri-State district contributed about 40,000 tons of the exports in 1925 and about 20,000 tons in 1926. In 1927 total exports of ore decreased to 46,716 tons, none of which was supplied by the tri-State district. Data are not available showing the source of exported ore by mining districts or States, but the following table shows the distribution by customs districts from which the ore was exported:

Domestic zinc ores and concentrates exported from the United States, 1925–1927, by customs districts, in short tons

District	1925	1926	1927
New York	3, 817	3, 622	
Buffalo			81
Dakota		1	
Galveston	479	5, 872	1, 902
Los Angeles	96	3, 527	1, 782
Maryland	68		
Michigan			37
New Orleans	36, 136	37, 050	15, 044
Oregon	19, 585	25, 209	15, 802
Philadelphia			7
Sabine	3, 240		
St. Lawrence	3	6	
San Francisco	5, 029	17, 889	10, 538
Washington	498	2, 076	1, 523
	68, 951	95, 252	46, 716

Exports to Belgium, the largest importer of American ores, decreased from 63,000 tons (66 per cent of the total ore exported) in 1926 to 28,500 tons (61 per cent of the total) in 1927. France, the second largest importer in 1927, took 14,000 tons (30 per cent of the total), compared with 10,000 tons (10 per cent of the total) in 1926. Exports of ore to Germany decreased from 18,000 to 1,200 tons. These three countries accounted for 96 per cent of the total ore exported in 1926 and for 94 per cent of the total in 1927.

Exports of plates and sheets decreased 15 per cent in 1927; the larger part of the decrease is attributable to decreased shipments to the United Kingdom, which takes about one-third of the total.

Exports of zinc dross, about half of which go to the United Kingdom, decreased 57 per cent in 1927.

The combined value of brass and bronze and of brass manufactures exported from the United States increased from $13,700,000 in 1926 to $17,500,000 in 1927, or 28 per cent. The value of the zinc content is estimated at approximately 17 per cent of the total. Exports of "ingots, scrap, and old" showed the greatest increase, nearly doubling in 1927. The United Kingdom and Canada are the largest consumers of American export brass.

Domestic zinc ore and domestic manufactures of zinc exported from the United States, 1918–1927

Year	Zinc ore and concentrates		Pigs or slabs		Plates and sheets		Zinc dross		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1918	62	$2,480	66,369	$12,469,622	13,875	$4,566,756	15,816	$2,238,913	(1)	(1)
1919			109,746	17,524,153	19,762	5,212,002	5,123	739,295	(1)	(1)
1920			74,046	12,495,144	11,852	2,832,993	2,445	316,637	(1)	(1)
1921			1,753	204,984	1,816	425,618	510	45,340	(1)	(1)
1922	1,695	33,592	26,815	2,994,625	3,217	574,491	8,412	662,080	1,998	$287,890
1923	[2] 2,804	(2)	42,131	5,961,525	3,732	764,369	[3] 14,745	[3] 1,221,986	3,679	507,289
1924	[2] 368	(2)	[4] 72,583	[4] 9,538,459	3,658	784,728	[3] 10,845	[3] 974,179	2,270	353,867
1925	68,951	3,277,118	[4] 76,351	[4] 11,654,441	4,196	926,841	15,968	1,567,697	2,242	408,017
1926	95,252	4,056,067	[4] 42,920	[4] 6,360,671	4,641	1,086,967	10,461	1,100,988	1,091	224,841
1927	46,716	1,690,523	[4] 45,695	[4] 6,035,382	3,922	869,425	4,451	296,489	1,357	259,209

[1] Figures not available prior to 1922.

[2] Not separately enumerated by Bureau of Foreign and Domestic Commerce in 1922 and 1923 but included with "Zinc dross"; Canadian smelters reported imports of 2,804 tons of zinc ore and concentrates from the United States in 1923: exporters from the Joplin district reported 368 tons of concentrates shipped to Belgian smelters in 1924.

[3] Exports of zinc ore and dross are lumped together; these figures include the quantity and value of zinc ore exported as shown in the first column.

[4] Exports of slab zinc made from foreign ore are not given separately but have been included with domestic exports after 1923.

Foreign zinc exported from the United States, 1918–1927

Year	Exported from warehouse			Exported in manufactures with benefit of drawback, slabs and sheets excluded (short tons)
	Blocks, pigs, and old		All other manufactures (value)	
	Short tons	Value		
1918	20,069	$3,565,127		6,337
1919	12,256	1,943,507	$13,071	4,533
1920	28,132	4,331,636		237
1921	1,256	100,677	10,785	130
1922	3,471	429,122	30,227	1,298
1923	7,080	941,257	(1)	
1924–1927	(2)	(2)	(2)	

[1] Not given separately.

[2] Exports of slab zinc made from foreign ore are not given separately but have been included with domestic exports after 1923.

Domestic zinc ore and domestic and foreign manufactures of zinc exported from the United States, 1926 and 1927, by destinations

Destination	Ore and concentrates		Slabs, blocks, or pigs		Sheets, strips, etc.	
	Short tons	Value	Short tons	Value	Short tons	Value
1926						
North America:						
Canada	85	$231	508	$79,772	1,430	$306,756
Cuba			(1)	56	115	28,319
Mexico			72	4,211	204	54,319
Panama			10	1,663	23	5,300
Other			8	1,517	80	16,043
	85	231	598	87,219	1,852	410,737
South America:						
Argentina			1,468	221,031	198	64,748
Brazil			38	7,235	65	22,423
Chile			471	69,249	22	7,728
Colombia			1	224	67	15,502

[1] Less than 1 ton.

Domestic zinc ore and domestic and foreign manufactures of zinc exported from the United States, 1926 and 1927, by destinations—Continued

Destination	Ore and concentrates		Slabs, blocks, or pigs		Sheets, strips, etc.	
	Short tons	Value	Short tons	Value	Short tons	Value
1926—Continued						
South America—Continued.						
Peru	--------	--------	5	$876	14	$4,390
Salvador	364	$10,922	--------	--------	--------	--------
Other	--------	--------	[1]	104	45	11,977
	364	10,922	1,983	298,719	411	126,768
Europe:						
Belgium	63,170	2,637,767	1,207	192,698	[1]	77
France	9,920	407,446	4,660	743,159	74	18,594
Germany	18,327	849,627	3,639	544,944	86	18,582
Italy	2,531	113,042	1,922	294,166	7	1,781
Netherlands	--------	--------	896	129,192	7	1,411
Soviet Russia	--------	--------	678	104,470	--------	--------
Sweden	--------	--------	392	63,758	30	10,638
United Kingdom	53	4,096	15,913	2,296,942	1,798	396,292
Other	--------	--------	235	36,653	35	10,866
	94,001	4,011,978	29,542	4,405,982	2,037	458,241
Asia:						
China	--------	--------	[1]	38	53	14,694
India (British)	--------	--------	829	130,797	7	2,484
Japan	--------	--------	9,700	1,397,499	147	34,572
Philippine Islands	--------	--------	4	685	45	11,210
Soviet Russia	--------	--------	229	33,759	[1]	77
Turkey	--------	--------	34	5,646	--------	--------
Other	--------	--------	--------	--------	9	3,311
	--------	--------	10,796	1,568,424	261	66,348
Oceania, including Australia	802	32,936	1	327	80	24,873
	95,252	4,056,067	42,920	6,360,671	4,641	1,086,967
1927						
North America:						
Canada	118	6,383	634	86,217	1,616	298,035
Cuba	--------	--------	6	1,589	47	14,891
Mexico	--------	--------	394	89,128	68	21,330
Panama	--------	--------	6	991	36	6,012
Other	--------	--------	1	213	29	7,497
	118	6,383	1,041	178,138	1,796	347,765
South America:						
Argentina	--------	--------	4,173	542,929	132	30,239
Brazil	--------	--------	52	7,392	45	15,931
Chile	--------	--------	906	144,849	26	9,659
Colombia	--------	--------	1	298	71	15,585
Peru	--------	--------	1	98	16	5,160
Other	--------	--------	[1]	135	56	11,840
	--------	--------	5,133	695,701	346	88,414
Europe:						
Belgium	28,525	937,190	813	124,563	--------	--------
France	14,128	497,805	3,190	394,656	--------	--------
Germany	1.215	87,300	1,939	253,747	110	23,090
Italy	--------	--------	2,257	308,345	--------	--------
Netherlands	1,207	53,930	555	68,570	10	1,590
Soviet Russia	--------	--------	890	118,399	--------	--------
Sweden	--------	--------	449	65,410	50	15,945
United Kingdom	--------	--------	20,518	2,658,903	1,230	291,478
Other	--------	--------	118	15,848	75	21,362
	45,075	1,576,225	30,729	4,008,441	1,475	353,465
Asia:						
China	--------	--------	2	361	24	8,367
India (British)	--------	--------	56	7,395	9	3,333
Japan	1,523	107,915	8,724	1,142,439	130	30,987
Philippine Islands	--------	--------	7	1,638	78	16,587
Other	--------	--------	--------	--------	11	3,806
	1,523	107,915	8,789	1,151,833	252	63,080
Africa	--------	--------	--------	--------	4	1,263
Oceania, including Australia	--------	--------	3	1,269	49	15,438
	46,716	1,690,523	45,695	6,035,382	3,922	869,425

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[1] Less than 1 ton.

Domestic brass[1] *and brass manufactures exported from the United States, 1918–1927*

[Zinc content approximately 30 per cent by weight]

Year	Bars, plates, and sheets		Scrap and old[2]		Articles made from brass (value)	Total value
	Short tons	Value	Short tons	Value		
1918	15,495	$9,522,934	2,455	$799,318	$19,483,146	$29,805,398
1919	3,885	2,310,561	661	176,028	11,426,289	13,912,878
1920	2,905	1,671,608	1,030	254,189	13,202,854	15,128,651
1921	1,437	741,110	2,969	405,871	7,123,366	8,270,347
1922	1,830	635,449	3,147	514,322	7,675,979	8,825,750
1923	1,733	703,503	6,587	1,198,560	6,917,901	8,819,964
1924	2,265	740,993	29,294	5,352,197	6,299,046	12,392,236
1925	3,988	1,359,594	48,189	9,889,153	7,315,707	18,564,454
1926	2,377	884,907	25,132	4,944,277	7,844,746	13,673,930
1927	1,756	648,853	45,997	8,824,029	8,043,131	17,516,013

[1] Beginning 1922, classification reads "Brass and bronze."
[2] Beginning 1925, classification reads "Ingots, scrap, and old."

CONSUMPTION

APPARENT CONSUMPTION OF PRIMARY SLAB ZINC

Primary zinc consumed in the United States, 1918–1927, in short tons

	1918	1919	1920	1921	1922
Supply:					
Stock Jan. 1—					
In bonded warehouse	32				131
At smelters	53,689	41,241	36,793	71,037	70,321
Production	517,927	465,743	463,377	200,500	354,277
Imports, foreign	35	70	15	6,739	52
Imports, domestic, returned			8,162	731	
Total available	571,683	507,054	508,347	279,007	424,781
Withdrawn:					
Exports, foreign, from warehouse	20,069	12,256	28,132	1,256	3,471
Exports, foreign, under drawback	6,337	4,533	237	130	1,298
Exports, domestic	80,244	129,508	85,898	3,569	30,032
Stock Dec. 31—					
In bonded warehouse				131	80
At smelters	41,241	36,793	71,037	70,321	16,810
Total withdrawn	147,891	183,090	185,304	75,407	51,691
Apparent consumption	423,792	323,964	323,043	203,600	373,090

	1923	1924	1925	1926	1927
Supply:					
Stock Jan. 1—					
In bonded warehouse	80	80	(1)		
At smelters	16,810	27,808	20,754	13,080	26,937
Production	510,434	517,339	572,946	618,422	592,516
Imports, foreign	21	25	24	22	59
Total available	527,345	545,252	593,724	631,524	619,512
Withdrawn:					
Exports, foreign, from warehouse	7,080	(2)	(2)	(2)	(2)
Exports, foreign, under drawback					
Exports, domestic	45,863	[2]76,241	[2]80,547	[2]47,561	[2]49,617
Stock Dec. 31—					
In bonded warehouse	80	(1)			
At smelters	27,808	20,754	13,080	26,937	53,522
Total withdrawn	80,831	96,995	93,627	74,498	103,139
Apparent consumption	446,514	448,257	500,097	557,026	516,373

[1] 998 pounds.
[2] Foreign exports included under domestic exports.

The foregoing table includes only primary slab zinc or zinc produced from ores. In addition, a substantial tonnage of redistilled secondary zinc is produced at primary smelters each year, most of which is inseparable from primary metal. For this reason smelter stocks at the end of the year and exports of domestic zinc probably contain some secondary metal. Although the amount is relatively small, the slight inconsistency in the table should be noted. A more precise segregation of figures for primary and secondary metal is practically impossible.

The apparent consumption of primary zinc decreased 7 per cent in 1927. Consumption of many of the other common metals decreased similarly. Production of iron and of steel decreased 7 per cent, and the consumption of copper and of lead decreased 9 and 8 per cent, respectively. Some of the factors contributing to these decreases were a reduction of 21 per cent in the number of automobiles and trucks produced, a decrease of 30 per cent in value of industrial construction contracts awarded, and substantial decreases in manufactures of railroad equipment.

CONSUMPTION BY USES

Zinc ore may be used for the manufacture of slab zinc, zinc dust, pigments, and salts. This chapter is chiefly concerned with slab zinc, and the discussion that follows is confined to the uses of that product

Besides the primary zinc consumed, as shown in the preceding table, a large quantity of secondary zinc was recovered in the form of slab zinc, brass and other alloys, pigments, salts, and zinc dust. These items have been discussed briefly in a previous section (p. 486) of this chapter and in more detail in the chapter of this series on secondary metals. The secondary zinc recovered in 1927 in the form of slab zinc, brass, and other alloys amounted to 140,400 tons. Owing to lack of data regarding stocks, it is impossible to state how much of this metal was actually consumed in 1927. It should be noted, however, that the quantity of secondary zinc recovered as slab zinc and in alloys during the last four years has averaged 27 per cent of the apparent consumption of primary zinc.

The three chief uses of slab zinc are in the manufacture of zinc-coated (galvanized) products, in brass making, and in the manufacture of sheet zinc. Other minor uses are in the manufacture of French oxide, lithopone, atomized zinc dust, die castings, and slush castings, and for the desilverization of lead. The following table, which shows the estimated industrial use of zinc in the United States from 1919 to 1927, has been taken from the Year Book of the American Bureau of Metal Statistics, 1927.

Estimated industrial use of zinc in the United States, 1919–1927, in short tons[1]

Purpose	1919	1920	1921	1922	1923	1924	1925	1926	1927
Galvanizing:									
Sheets	81,500	99,800	72,500	110,800	121,300	122,900	138,000	142,500	138,500
Tubes	27,900	34,000	28,200	44,100	49,000	50,300	61,100	62,100	54,000
Wire	33,900	35,900	19,500	25,000	32,700	29,000	35,700	34,200	38,500
Wire cloth	4,300	4,800	3,800	6,100	6,100	7,100	6,800	6,800	6,500
Shapes[2]	15,400	17,500	14,100	19,400	26,100	30,700	41,400	44,400	42,500
	163,000	192,000	138,100	205,400	235,200	240,000	283,000	290,000	280,000
Brass making	155,000	144,000	75,000	145,000	175,000	155,000	165,000	180,000	160,000
Rolled zinc	55,000	53,200	30,400	53,500	55,800	61,000	71,100	86,300	74,100
Other purposes[3]	29,000	35,000	19,000	36,000	49,000	56,000	60,000	66,000	68,000
	402,000	424,200	262,500	439,900	515,000	512,000	579,100	622,300	582,100

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[1] Year Book, American Bureau of Metal Statistics, 1927, p. 73.

[2] Includes pole-line hardware, hollow ware, chains, and all articles not elsewhere mentioned. The estimates for the use of slab zinc under this head, and also for wire cloth, are probably incomplete. The enumeration for 1924 includes figures from consumers not previously accounted for.

[3] Includes slab zinc used for manufacture of French oxide, lithopone, atomized zinc dust, die castings, slush castings, and for the desilverization of lead.

As shown in the foregoing table, the decrease in consumption of zinc in 1927 amounted to 6.5 per cent, compared with a decrease of 7 per cent in the apparent consumption of primary zinc as computed by the Bureau of Mines. This slight difference may be accounted for by the fact that the consumption shown in the preceding table includes a large part of the unalloyed secondary metal recovered in 1927, which increased slightly over 1926. The following compilation shows the relation between these figures:

Comparison of figures for consumption of zinc, 1923–1927, as computed by Bureau of Mines and by American Bureau of Metal Statistics, in short tons

	1923	1924	1925	1926	1927
Apparent consumption of primary zinc as per Bureau of Mines	446, 514	448, 257	500, 097	557, 026	516, 373
Industrial use of zinc as per American Bureau of Metal Statistics	515, 000	512, 000	579, 100	622, 300	582, 100
Excess as per American Bureau of Metal Statistics	68, 486	63, 743	79, 003	65, 274	65, 727
Recovery of unalloyed secondary zinc as per Bureau of Mines	65, 210	58, 886	61, 430	64, 570	64, 800

The galvanizing industry is the largest user of slab zinc and has accounted for 47 per cent of the total zinc used in the United States during the last five years. Its consumption of slab zinc in 1927 was only three per cent less than in 1926.

Brass making provides the second largest use of slab zinc and has accounted for 30 per cent of the total consumption during the last five years. It is of interest to note that the use of zinc in brass has not kept pace with the general increase in consumption. In 1922 about 33 per cent of the total slab zinc was used in brass, whereas in 1927 the percentage had decreased to 27.5 per cent.

During the four years preceding 1927 the manufacture of rolled zinc showed a substantial increase. In 1923, 55,800 tons of zinc was used, representing 11 per cent of the total consumption; in 1926, 86,300 tons, or 14 per cent of the total, was used. In 1927 the quantity of zinc used decreased to 13 per cent of the total. Thirty-four per cent of the zinc rolled in 1926 and 1927 combined went into sheets of ordinary thickness, 2 per cent into boiler plate, and 64 per cent into strip and ribbon zinc.

According to data collected by the Bureau of Mines, 34,000 tons of zinc was contained in zinc oxide produced from metallic zinc in 1927. This accounts for more than half of the "Other purposes" item in the consumption table of the American Bureau of Metal Statistics, if allowance is made for manufacturing losses. During 1926 and 1927 no atomized zinc dust was produced in the United States, but prior to 1926 1,000 to 4,000 tons of zinc was used annually for this purpose. The use of zinc in castings, especially die castings, appears to be increasing; although complete data are lacking, it is estimated that the quantity of zinc used for this purpose did not exceed 20,000 tons in 1927. Several thousand tons of zinc is probably used annually in the Parkes process of desilverizing lead, but no data as to the exact amount are available.

PRICES AND VALUE

The price of zinc declined notably in 1927 as a result of curtailed consumption. The average quoted price of prime western zinc at

St. Louis was 6.25 cents per pound, as compared with 7.37 cents in 1926. The year opened with zinc quoted at 7 cents, the highest for the year. Continuing the decline which began in the latter part of 1926, the trend was steadily downward, finally reaching 6 cents in the latter part of May. During June the price fluctuated somewhat but on the whole increased, ending the month with quotations at 6.17½ cents. Up to this time stocks had accumulated rapidly, but in July smelter production was curtailed considerably, resulting in decreased stocks and a steady increase in price. At the end of July zinc was quoted at 6.35 cents. Notwithstanding steady decreases in stocks through October, the price of zinc fluctuated and gradually declined to 5.60 cents, the low price for the year, by November 10. Among the various reasons advanced for this decline in price were the conservative buying policy of the consuming industries, the lack of curtailment on the part of ore producers, and the falling off of exports during this period. During the latter part of November the price rose to 5.90 cents but declined again in December. The quotation at the end of the year was 5.65 cents.

The following table shows the monthly fluctuations in price of prime western zinc at St. Louis during 1922 to 1927 and at London during 1927:

Average monthly quoted price of zinc at St. Louis, 1922–1927, and at London, 1927, in cents a pound[1]

Month	St. Louis (for immediate delivery)						London,[2] 1927
	1922	1923	1924	1925	1926	1927	
January	4.71	6.96	6.42	7.76	8.45	6.68	6.71
February	4.50	7.25	6.76	7.51	7.84	6.69	6.48
March	4.65	7.87	6.49	7.34	7.34	6.71	6.64
April	4.91	7.32	6.13	7.00	7.01	6.35	6.42
May	5.10	6.72	5.78	6.96	6.82	6.08	6.30
June	5.35	6.05	5.79	7.00	7.12	6.23	6.20
July	5.77	6.09	5.90	7.22	7.42	6.24	6.14
August	6.24	6.35	6.18	7.59	7.39	6.36	6.12
September	6.56	6.46	6.19	7.77	7.42	6.22	5.93
October	6.85	6.30	6.33	8.33	7.31	6.00	5.85
November	7.14	6.36	6.80	8.72	7.22	5.75	5.71
December	7.12	6.25	7.38	8.71	7.04	5.73	5.74
High	7.14	7.87	7.38	8.72	8.45	6.71	6.71
Low	4.50	6.05	5.78	6.96	6.82	5.73	5.71
Average	5.74	6.66	6.35	7.66	7.37	6.25	6.19

[1] Metal Statistics, 1928, pp. 425 and 433.
[2] Conversion of English quotations into American money based on average monthly rate of exchange, as recorded by the Federal Reserve Board of the Treasury.

New York quoted prices are slightly above St. Louis prices, owing to the freight rate of 0.35 cent per pound between the two places.

The Joplin ore market followed the same general trend. The year opened with 60 per cent grade of zinc concentrates quoted at $46 per ton. The low for the year was $35 the first part of November and at the end of the year. The average price realized on all shipments during the year as reported by the American Metal Market was $41.02, compared with $48.94 in 1926. The following table shows the average weekly price fluctuations of zinc concentrates at Joplin and of prime western and brass special zinc at St. Louis.

Average weekly quoted prices of 60 per cent zinc concentrates at Joplin, Mo., and of zinc of "prime western" and "brass special" grades at St. Louis, in 1927

Week ended—	60 per cent zinc concentrates in the Joplin region (dollars per ton)[1]	Prime western zinc in St. Louis (cents per pound)[2]	Brass special zinc in St. Louis (cents per pound)[2]	Week ended—	60 per cent zinc concentrates in the Joplin region (dollars per ton)[1]	Prime western zinc in St. Louis (cents per pound)[2]	Brass special zinc in St. Louis (cents per pound)[2]
Jan. 1	46	7.01½	7.07½	July 2	41–42	6.20¾	6.25¾
Jan. 8	45	6.94½	7.00¼	July 9	42	6.17 3/16	6.22 3/16
Jan. 15	44	6.79½	6.85¼	July 16	42–43	6.18½	6.23½
Jan. 22	42	6.55¼	6.60¾	July 23	43	6.25¼	6.30¾
Jan. 29	42	6.46½	6.52	July 30	43	6.34	6.40¼
Feb. 5	42	6.57¼	6.61¾	Aug. 6	43	6.41½	6.49½
Feb. 12	43	6.61½	6.74½	Aug. 13	43	6.37¾	6.45
Feb. 19	44	6.68	6.74½	Aug. 20	42	6.38¼	6.45
Feb. 26	45	6.63¾	6.89 1/16	Aug. 27	42	6.29¾	6.38
Mar. 5	45	6.83¼	6.90¼	Sept. 3	42	6.26¾	6.35
Mar. 12	45	6.77¼	6.84½	Sept. 10	42	6.26⅞	6.35
Mar. 19	45	6.71¾	6.79	Sept. 17	41	6.26½	6.33¼
Mar. 26	44	6.66½	6.73	Sept. 24	40	6.21½	6.26½
Apr. 2	43	6.56¼	6.63¼	Oct. 1	38	6.11½	6.16½
Apr. 9	42	6.51½	6.57½	Oct. 8	38	6.02¾	6.07¾
Apr. 16	42	6.40	6.45	Oct. 15	38	6.09⅜	6.14 11/16
Apr. 23	41	6.33½	6.38½	Oct. 22	38	6.02½	6.08½
Apr. 30	40	6.13	6.19¾	Oct. 29	37	5.90½	5.98¼
May 7	39	6.13¾	6.18¾	Nov. 5	35	5.77	5.82
May 14	38	6.11¾	6.17½	Nov. 12	35	5.62½	5.67½
May 21	38	6.04½	6.10½	Nov. 19	36	5.69½	5.74
May 28	38	6.03¼	6.08¼	Nov. 26	37	5.84⅜	5.96¼
June 4	39	6.17 3/16	6.22 3/16	Dec. 3	37	5.87½	5.92½
June 11	39–40	6.26¼	6.31¼	Dec. 10	37	5.84	5.89
June 18	40	6.24 11/16	6.30	Dec. 17	36	5.72¾	5.78
June 25	40–42	6.19½	6.24½	Dec. 24	35	5.64¾	5.70
				Dec. 31	35	5.64 11/16	5.70

[1] Joplin Globe, Joplin, Mo.
[2] American Metal Market, monthly review section.

The following table shows the actual prices received by producers for various grades of zinc based on the producer's classification of products, and the total value reported received:

Average price of zinc, 1918–1927, by grades, in cents per pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Grade A (high grade)	11.1	8.3	8.4	5.6	6.0	7.1	6.8	7.85	7.65	6.67
Grade B (intermediate)	10.7	7.7	8.3	5.5	6.0	7.1	6.8			
Grade C (select and brass special)	8.0	7.2	8.2	4.9	5.6	6.7	6.4	7.41	7.35	6.24
Grade D (prime western)	7.9	7.1	8.0	4.9	5.6	6.7	6.4	7.59	7.46	6.31
All grades	9.1	7.3	8.1	5.0	5.7	6.8	6.5	7.6	7.5	6.4
Prime western; average spot quotation at St. Louis	8.0	7.0	7.8	4.7	5.7	6.7	6.4	7.7	7.4	6.3

The American Metal Market reported the following average quoted prices (cents per pound) for 1927:

High-grade zinc (delivered at eastern points)	8.23
Brass special (f. o. b. East St. Louis)	6.31
Prime western (f. o. b. St. Louis)	6.25
Prime western (f. o. b. New York)	6.60

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By C. N. Gerry[1]

SUMMARY

In 1927 the total value of the mine production of gold, silver, copper, lead, and zinc in Nevada was 5 per cent less than in 1926. The decrease in ore output and the consequent decrease in metal output were due entirely to the decline in metal prices. The quantity and value of each metal except copper decreased. The largest decrease in value was in silver; the decreases in value of gold, lead, and zinc, however, were considerable. Four mining companies published or reported to the Bureau of Mines dividends that amounted to $2,994,760, paid in 1927.

The value of the metal output of White Pine County was $15,282,846, nearly twice as much as that of all other counties combined, on account of the large production of copper ore from mines at Ely, where the output was decidedly increased over that of 1926. Three other counties—Nye, Lyon, and Esmeralda—each produced metals worth more than $1,000,000; Elko, Lincoln, and Lander Counties followed in order. The large increase (nearly $1,500,000) in the value of copper from the mines in the copper regions of White Pine and Lyon Counties was more than offset by the marked decrease in the value of gold and silver from Storey County (Comstock district). This unusual decrease in Storey County was caused by the closing of the property of the Comstock Merger Mines (Inc.), which was the largest producer of both gold and silver in Nevada in 1926 and which was first in gold and second in silver in 1925.

The total value of the mine production of gold, silver, copper, lead, and zinc in Nevada for the years 1904 to 1927, inclusive, as recorded in Mineral Resources, was $653,799,250. Details of production are as follows: Ore, old tailings, etc., 87,558,470 short tons; gold, $202,206,433; silver, 235,591,750 fine ounces ($161,757,051); copper, 1,439,567,874 pounds ($247,882,085); lead, 338,962,434 pounds ($21,789,763); and zinc, 232,256,279 pounds ($20,163,918).

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only;

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[1] The valuable assistance of B. N. Lowry and Paul Luff, of the Bureau of Mines, is acknowledged.

for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1918–1927

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1918	660	54	6,472,579	320,239.45	$6,619,937	10,000,599	$10,000,599
1919	384	37	3,187,831	219,695.16	4,541,502	6,863,580	7,687,210
1920	434	39	3,480,620	172,540.46	3,566,728	7,745,093	8,442,151
1921	370	61	1,096,138	160,254.62	3,312,757	7,083,782	7,083,782
1922	345	42	1,565,276	159,510.95	3,297,384	8,619,587	8,619,587
1923	354	35	4,354,937	204,292.89	4,223,109	10,614,564	8,703,942
1924	348	36	4,699,333	217,962.56	4,505,686	9,411,379	6,305,624
1925	399	25	4,927,139	187,104.72	3,867,798	7,096,618	4,925,053
1926	377	28	5,884,568	175,381.68	3,625,461	6,518,983	4,067,845
1927	379	30	5,531,152	150,346.16	3,107,931	5,397,179	3,060,200

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	116,316,441	$28,730,161	23,316,534	$1,655,474	16,724,753	$1,521,953	$48,528,124
1919	52,331,175	9,733,599	15,349,370	813,517	9,004,698	657,343	23,433,171
1920	50,559,763	9,302,996	21,263,700	1,701,096	10,698,040	866,541	23,879,512
1921	10,961,491	1,414,032	7,188,768	323,495	69,397	3,470	12,137,536
1922	23,133,091	3,122,967	9,389,182	516,405	2,618,710	149,266	15,705,609
1923	67,204,282	9,879,029	18,156,337	1,270,944	14,166,550	963,325	25,040,349
1924	73,805,323	9,668,497	20,060,041	1,604,803	11,002,910	715,189	22,799,799
1925	79,300,224	11,260,632	24,476,452	2,129,451	14,821,293	1,126,418	23,309,352
1926	101,827,937	14,255,911	22,367,965	1,789,437	10,817,833	811,337	24,549,991
1927	120,259,276	15,753,965	15,784,818	994,444	6,344,523	406,049	23,322,589

Gold and silver produced at placer mines in Nevada, 1918–1927

Year	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
1918	10,564.13	$218,380	3,907	$3,907
1919	6,399.43	132,288	2,374	2,659
1920	7,383.91	152,639	3,296	3,593
1921	17,566.99	363,142	7,956	7,956
1922	11,602.36	239,842	4,710	4,710
1923	3,941.83	81,485	1,783	1,462
1924	1,323.97	27,369	546	366
1925	2,536.54	52,435	1,285	892
1926	2,866.17	59,249	1,494	932
1927	1,809.22	37,400	740	419

GOLD

The mine production of gold in Nevada decreased from $3,625,461 in 1926 to $3,107,931 in 1927, and was the smallest production recorded since that for 1903. Ore was treated by amalgamation in 14 counties, and ore and old tailings were treated by cyanidation in 11 counties in 1927. By these two methods of treatment $1,565,421 in gold was recovered from 322,530 tons of ore and 140,060 tons of old tailings. Most of the placer gold in 1927 was obtained by hydraulic and drift mining in the Round Mountain and Manhattan districts, Nye County, and by rocker and hydraulic mining in the Battle Mountain district, Lander County. Amalgamation and cyanidation mills yielded 50 per cent of the total gold, concentrates 32 per cent, and crude smelting ore 17 per cent.

Nine properties supplied 70 per cent of the total gold from Nevada in 1927, each of these producing more than 6,000 ounces. The Nevada Consolidated property at Ely was first, followed by the Elkoro at Jarbidge, the Consolidated Coppermines at Kimberly, the White Caps at Manhattan, the Flowery at Virginia City, the Goldfield Consolidated tailing dump (Bradshaw, Inc.) at Goldfield, the Tonopah Mining and the Tonopah Extension, both at Tonopah, and the Gold Circle Consolidated at Midas.

SILVER

In 1927 the mine production of silver in Nevada was 5,397,179 fine ounces, decidedly less than the yearly average (7,935,136 ounces) for the decade 1918 to 1927, and was the smallest production recorded since that for 1904. The decrease in quantity in 1927 was 17 per cent, and was due chiefly to the closing of the Comstock Merger property. The decrease in total value was 25 per cent, as the average price of silver decreased from 62.4 cents an ounce in 1926 to 56.7 cents in 1927. The largest decreases were in Storey, Nye, Lander, and Mineral Counties, and the decrease in Storey County exceeded the combined decreases in all other counties. In Nye County 1,294,630 ounces of silver was contained in bullion recovered at amalgamation and cyanidation mills; most of this silver, or 1,292,411 ounces, was recovered by cyanidation. The Tonopah district in Esmeralda and Nye Counties produced 2,167,694 ounces of silver in 1927, compared with 2,052,956 ounces in 1926. Other districts that were important producers of silver in 1927 were the Lewis (in Lander County), the Cortez (in Eureka County), the Jack Rabbit (in Lincoln County), and the Divide (in Esmeralda County). In the Comstock district, Storey County, the output of silver in 1927 was only 62,051 ounces, most of which was recovered by cyanidation; in 1926 the district produced 1,534,116 ounces. Concentrates yielded 1,487,627 ounces of silver, compared with 1,478,537 ounces in 1926. Lead concentrates yielded 1,259,261 ounces of silver, an average recovery of 192.34 ounces per ton, compared with 1,223,988 ounces, an average of 96.03 ounces, in 1926.

Eight properties, each producing more than 200,000 ounces, yielded 71 per cent of the total silver from Nevada in 1927. These properties, in order of output, were the Betty O'Neal near Battle Mountain, the Tonopah Extension and the Tonopah Mining, both at Tonopah, the

Consolidated Cortez at Cortez, the Tonopah Belmont at Tonopah, the Bristol Silver at Pioche, the West End Consolidated at Tonopah, and the Tonopah Divide at Divide in Esmeralda County.

COPPER

In 1927 the mine production of copper in Nevada was 120,259,276 pounds, an increase of 18 per cent over 1926 and the largest output ever recorded except that of 1917, when nearly 123,000,000 pounds was produced. The total value increased nearly $1,500,000, or 10.5 per cent, over 1926. Concentrates yielded nearly 91 per cent of the total copper, and crude ore shipped to smelters yielded nearly 9 per cent. The Nevada Consolidated Copper Co. at Ely, White Pine County, produced a little less copper in 1927 than in 1926; its average output per month was approximately 7,400,000 pounds. Shipments of first-class ore and mill ore from the property of the Consolidated Coppermines to the smelter and mill of the Nevada Consolidated Copper Co. at McGill increased considerably; the company produced more than three times as much copper in 1927 as in 1926. The Mason Valley Mines Co. increased its output of copper nearly 77 per cent.

Three properties—the Nevada Consolidated Copper, the Consolidated Coppermines, and the Mason Valley Mines—yielded more than 97 per cent of the total copper from Nevada in 1927. The next largest producers were the Bristol Silver mine at Pioche and the Copper Canyon property at Battle Mountain.

LEAD

The mine production of lead in Nevada in 1927 was 15,784,818 pounds, a decrease of 29 per cent from 1926, and was less than the yearly average (about 17,735,300 pounds) for the decade 1918 to 1927. The largest decreases in 1927 were in Eureka and Lincoln Counties; the combined decrease in these two counties amounted to nearly 5,500,000 pounds. Nearly 26 per cent of the total lead was derived from concentrates of milling ore and old tailings and nearly 74 per cent from crude ore shipped direct to smelters. Lead concentrates (carbonates and sulphides) shipped to smelters yielded 3,959,709 pounds of lead, an average of 30.24 per cent, compared with 9,218,671 pounds, or 36.16 per cent, in 1926. The total crude ore of shipping grade yielded 11,634,737 pounds of lead, compared with 12,348,201 pounds in 1926. Oxidized lead ore shipped to smelters yielded 4,702,902 pounds of lead and sulphide ore 3,373,840 pounds, compared with 6,418,501 pounds and 3,483,017 pounds, respectively, in 1926. First-class oxidized copper-lead ore yielded 2,563,056 pounds of lead and sulphide ore 1,546 pounds. The lead-zinc ore of smelting grade (all of which was oxidized ore) yielded 963,719 pounds of lead, and the dry and siliceous ore of smelting grade yielded 29,656 pounds.

Nine mines yielded nearly 72 per cent of the total lead from Nevada in 1927. The Bristol Silver at Pioche, Lincoln County, was the largest producer, and was followed in order by the San Rafael in Nye County, the Richmond-Eureka in Eureka County, the Yellow

Pine in Clark County, the Combined Metals in Lincoln County, the Eureka-Holly in Eureka County, the Panther Mines in Elko County, the Simon Silver-Lead in Mineral County, and the Silver Age in White Pine County.

ZINC

In 1927 the mine production of zinc in Nevada was 6,344,523 pounds, or 41 per cent less than in 1926. This decrease was largely due to the great decrease in production from the property of the Combined Metals Reduction Co. at Pioche, Lincoln County. The Yellow Pine district, Clark County, produced 56 per cent of the total zinc output of the State in 1927, and was followed by the Pioche district in Lincoln County. The zinc output of the Bell district in Mineral County was considerably less than in 1926. Sulphide zinc-lead ore from Pioche was treated by flotation in the plant of the Combined Metals Reduction Co. at Bauer, Utah; the resulting lead concentrate was shipped to International, Utah, and the zinc product to the electrolytic zinc plant near Great Falls, Mont. The Yellow Pine Mining Co. at Goodsprings shipped carbonate ore to eastern zinc plants. The Simon Silver-Lead Mines (Inc.) at Simon, Mineral County, shipped both zinc concentrate and lead concentrate; the mill was run only until January 28, after which it closed on account of the low prices for lead and zinc.

Two properties—the Yellow Pine at Goodsprings in Clark County and the Combined Metals at Pioche in Lincoln County—yielded 80 per cent of the total zinc from Nevada in 1927. The Potosi mine near Arden in Clark County, the Simon Silver-Lead property near Mina in Mineral County, and the Anchor mine near Goodsprings in Clark County also produced much zinc.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1927, by counties

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Churchill	60.37	$1,248			$1,248	7,078	$4,013
Clark	1,286.39	26,592			26,592	15,843	8,983
Douglas	18.72	387	12.34	$255	642	1,222	693
Elko	24,271.58	501,738			501,738	302,480	171,506
Esmeralda	22,643.56	468,084			468,084	1,117,058	633,372
Eureka	2,676.78	55,334	190.21	3,932	59,266	619,883	351,474
Humboldt	170.81	3,531	16.30	337	3,868	10,806	6,127
Lander	1,019.80	21,081	225.81	4,668	25,749	801,938	454,699
Lincoln	762.82	15,769			15,769	380,112	215,524
Lyon	1,659.89	34,313	8.71	180	34,493	54,671	30,998
Mineral	2,139.24	44,222	21.33	441	44,663	117,490	66,617
Nye	29,540.10	610,648	1,182.48	24,444	635,092	1,527,312	865,986
Ormsby	.92	19			19	524	297
Pershing	2,366.41	48,918	63.90	1,321	50,239	168,327	95,441
Storey	11,401.50	235,690			235,690	62,051	35,183
Washoe	402.82	8,327			8,327	3,796	2,152
White Pine	48,115.23	994,630	88.14	1,822	996,452	206,588	117,135
	148,536.94	3,070,531	1,809.22	37,400	3,107,931	5,397,179	3,060,200
Total, 1926	172,515.51	3,566,212	2,866.17	59,249	3,625,461	6,518,983	4,067,845

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1927, by counties—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	443	$58	142,859	$9,000			$14,319
Clark	9,879	1,294	1,690,443	106,498	3,546,078	$226,949	370,316
Douglas			13,075	824			2,159
Elko	327,329	42,880	2,372,428	149,463	40,197	2,573	868,160
Esmeralda	2,252	295	152,237	9,591	3,142	201	1,111,543
Eureka	52,758	6,911	2,440,127	153,728			571,379
Humboldt	595	78	5,854	369			10,442
Lander	1,367,637	179,161	402,496	25,357	20,510	1,312	686,278
Lincoln	1,434,702	187,946	3,938,036	248,096	2,438,395	156,057	823,392
Lyon	9,518,447	1,246,917	3,486	220			1,312,628
Mineral	48,962	6,414	654,930	41,261	285,406	18,266	177,221
Nye	37,880	4,962	2,401,916	151,321			1,657,361
Ormsby	240	31					347
Pershing	552	72	96,972	6,109			151,861
Storey	1,100	144					271,017
Washoe	420	55	11,269	710	1,191	76	11,320
White Pine	107,456,080	14,076,747	1,458,690	91,897	9,604	615	15,282,846
	120,259,276	15,753,965	15,784,818	994,444	6,344,523	406,049	23,322,589
Total, 1926	101,827,937	14,255,911	22,367,965	1,789,437	10,817,833	811,337	24,549,991

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Nevada, 1926–27, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1926	1927	1926	1927	1926	1927
Churchill	896	368	8	7	$24.00	$14.30
Clark	13,025	11,469	36	24	7.07	3.10
Douglas	64	54	4	3	21.17	20.00
Elko	64,725	56,279	35	39	9.90	11.96
Esmeralda	34,130	220,759	37	39	14.97	4.99
Eureka	34,968	50,888	18	11	5.08	7.99
Humboldt	413	520	13	10	16.24	18.57
Lander	75,349	32,846	21	25	10.01	14.48
Lincoln	69,096	42,001	12	10	4.16	5.51
Lyon	248,538	427,000	14	21	.24	.15
Mineral	40,410	8,500	41	41	5.34	13.04
Nye	138,784	79,374	51	58	13.07	18.60
Ormsby	1	8	1	1	28.00	39.50
Pershing	1,341	25,419	26	20	19.30	5.68
Storey	481,767	81,827	18	20	4.44	3.31
Washoe	560	348	13	13	50.21	30.11
White Pine	4,680,501	4,493,492	29	37	.18	.25
	5,884,568	5,531,152	377	379	1.30	1.11

Production of placer mines in Nevada in 1927, by counties

County	Mines		Gold	Silver (fine ounces)	Total value
	Drift	Hydraulic and sluicing			
Douglas		1	$255		$255
Eureka		2	3,932	14	3,940
Humboldt	1	1	337	2	338
Lander	3	4	4,668	30	4,685
Lyon		1	180	5	183
Mineral		1	441	5	444
Nye	2	9	24,444	662	24,819
Pershing		2	1,321	11	1,327
White Pine		3	1,822	11	1,828
	6	24	37,400	740	37,819
Total, 1926	4	24	59,249	1,494	60,181

MINING INDUSTRY

As the average prices for silver, copper, lead, and zinc in 1927 were lower than in 1926, there was a general decrease in 1927 in the output of the metals (except copper) in Nevada. The main feature of the year, and one which prevented a larger decrease in the total value of the metal output, was the activity at the copper mines at Ely, White Pine County. The notable decrease in the gold output resulted from the idleness of the Comstock Merger property in the Comstock district, Storey County.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Nevada, 1918–1927, with content in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
			DRY AND SILICEOUS ORE			
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	1,394,583	257,063.06	9,152,376	70,634	5,516,226	
1919	783,567	194,008.03	6,306,583	191,763	5,987,127	
1920	799,207	136,058.51	6,939,579	168,534	5,789,125	
1921	667,560	133,294.94	6,539,514	229,989	1,574,307	
1922	871,883	140,506.36	7,809,857	146,038	922,499	
1923	1,371,970	167,194.50	9,084,056	776,393	4,632,914	
1924	1,066,479	181,627.55	8,002,859	303,183	2,438,701	
1925	844,948	140,878.25	5,261,402	51,838	1,016,134	
1926	806,518	126,615.10	4,509,178	51,778	867,426	
1927	515,825	94,707.50	3,419,940	41,023	179,711	
			COPPER ORE			
1918	4,994,804	49,186.44	278,615	116,109,020	69,172	
1919	2,363,189	16,254.92	73,371	52,042,089	6,471	
1920	2,616,237	22,924.19	82,977	49,858,120	4,871	
1921	401,153	4,747.21	19,323	10,318,851	21	
1922	629,408	4,400.63	17,127	[1] 22,640,042	424	
1923	2,833,908	29,551.13	84,568	66,089,635	2,697	
1924	3,505,301	32,314.93	106,614	[1] 73,325,336		
1925	3,923,158	35,515.84	125,477	[1] 78,795,059		
1926	4,888,681	36,408.95	142,316	[1] 100,870,898	1,417	
1927	4,885,052	46,883.96	183,525	[1] 118,667,453	18	
			LEAD ORE			
1918	48,169	2,311.40	429,917	69,838	12,972,922	
1919	19,152	2,481.11	373,518	71,862	6,121,663	
1920	40,544	3,237.01	520,971	158,364	11,111,973	
1921	25,597	4,614.98	496,826	384,739	5,415,434	
1922	39,462	2,979.85	698,590	331,168	6,266,647	
1923	84,764	2,571.61	1,238,842	300,625	8,352,022	
1924	81,202	1,995.82	1,093,429	154,363	10,314,895	
1925	94,769	6,882.73	1,361,753	351,494	16,131,583	
1926	111,265	8,538.16	1,395,285	252,687	14,254,647	
1927	75,924	6,214.20	1,405,418	181,972	10,160,264	
			COPPER-LEAD ORE			
1918	800	929.14	12,218	63,410	241,583	
1919	4,996	511.52	3,345	24,871	92,413	
1920	6,269	2,936.41	114,358	374,745	1,340,286	
1921	1,689	30.50	20,163	27,912	154,288	
1922	102	1.90	2,153	11,283	39,869	
1923	330	708.16	13,089	21,769	60,558	
1924	3	.05	1,786	489	893	
1925	125	4.87	3,259	11,426	43,851	
1926	10,151	203.51	147,470	594,800	1,285,217	
1927	25,304	416.89	280,713	1,323,304	2,564,602	

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[1] Includes copper saved from precipitates recovered from mine water.

Ore, old tailings, etc., sold or treated in Nevada, 1918–1927, with content in terms of recovered metals—Continued

ZINC ORE AND LEAD-ZINC ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	34, 223	185. 28	123, 566	3, 539	4, 516, 631	16, 724, 753
1919	16, 927	40. 15	104, 389	590	3, 141, 696	9, 004, 698
1920	18, 363	. 43	83, 912	------------	3, 017, 445	10, 698, 040
1921	139	------------	------------	------------	44, 718	69, 397
1922	24, 421	19. 85	87, 150	4, 560	2, 159, 743	2, 618, 710
1923	63, 965	325. 66	192, 226	15, 860	5, 108, 146	14, 166, 550
1924	46, 348	700. 24	206, 145	21, 952	7, 305, 552	11, 002, 910
1925	64, 139	1, 286. 49	343, 442	90, 407	7, 284, 884	14, 821, 293
1926	67, 953	749. 79	323, 240	57, 774	5, 959, 258	10, 817, 833
1927	29, 047	314. 39	106, 843	45, 524	2, 880, 223	6, 344, 523

Ore, old tailings, etc., sold or treated in Nevada in 1927, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	158	[1] 294, 308	5. 32	66, 615. 25	44. 31	282, 612	5. 24
Dry gold and silver ore	17	[2] 5, 269	. 09	1, 268. 99	. 85	56, 984	1. 06
Dry silver ore	67	[3] 216, 248	3. 91	26, 823. 26	17. 84	3, 080, 344	57. 07
Copper ore	26	4, 885, 052	88. 32	46, 883. 96	31. 18	183, 525	3. 40
Lead ore	113	[4] 75, 924	1. 37	6, 214. 20	4. 13	1, 405, 418	26. 04
Zinc ore	4	1, 465	. 03	------------	--------	------------	------
Copper-lead ore	7	25, 304	. 46	416. 89	. 28	280, 713	5. 20
Lead-zinc ore	16	27, 582	. 50	314. 39	. 21	106, 843	1. 98
Total, lode mines	[5] 379	5, 531, 152	100. 00	148, 536. 94	98. 80	5, 396, 439	99. 99
Total, placers	30	------------	--------	1, 809. 22	1. 20	740	. 01
	409	5, 531, 152	100. 00	150, 346. 16	100. 00	5, 397, 179	100. 00
Total, 1926	405	5, 884, 568	--------	175, 381. 68	--------	6, 518, 983	------

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	4, 686	----------	448	----------	------------	----------
Dry gold and silver ore	7, 290	----------	65, 000	0. 41	------------	----------
Dry silver ore	29, 047	0. 03	114, 263	. 72	------------	----------
Copper ore	[6] 118, 667, 453	98. 68	18	----------	------------	----------
Lead ore	181, 972	. 15	10, 160, 264	64. 37	------------	----------
Zinc ore	------------	----------	------------	----------	917, 108	14. 46
Copper-lead ore	1, 323, 304	1. 10	2, 564, 602	16. 25	------------	----------
Lead-zinc ore	45, 524	. 04	2, 880, 223	18. 25	5, 427, 415	85. 54
	[6] 120, 259, 276	100. 00	15, 784, 818	100. 00	6, 344, 523	100. 00
Total, 1926	[7] 101, 827, 937	----------	22, 367, 965	----------	10, 817, 833	----------

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[1] Includes 136,900 tons of old tailings cyanided, 3,000 tons of old tailings reconçentrated, and 1 ton of sweepings sold to a smelter.

[2] Includes 800 tons of old tailings cyanided, 5 tons of old tailings reconcentrated, and 1,448 tons of old tailings sold to a smelter.

[3] Includes 2,360 tons of old tailings cyanided and 32,000 tons of old tailings reconcentrated.

[4] Includes 1 ton of slag sold to a smelter.

[5] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

[6] Includes 189,554 pounds of copper saved from precipitates recovered from mine water, largely from leaching of ore in place.

[7] Includes 341,843 pounds of copper saved from precipitates recovered from mine water, largely from leaching of ore in place.

Value of metals from ore, old tailings, etc., sold or treated in Nevada in 1927, by kinds of ore

Kind of ore	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	294, 308	$1, 377, 059	$160, 241	$614	$28		$1, 537, 942
Dry gold and silver ore	5, 269	26, 232	32, 310	955	4, 095		63, 592
Dry silver ore	216, 248	554, 486	1, 746, 555	3, 805	7, 199		2, 312, 045
Copper ore	4, 885, 052	969, 178	104, 059	[1] 15, 545, 436	1		16, 618, 674
Lead ore	75, 924	128, 459	796, 872	23, 838	640, 097		1, 589, 266
Zinc ore	1, 465					$58, 695	58, 695
Copper-lead ore	25, 304	8, 618	159, 164	173, 353	161, 570		502, 705
Lead-zinc ore	27, 582	6, 499	60, 580	5, 964	181, 454	347, 354	601, 851
	5, 531, 152	3, 070, 531	3, 059, 781	[1] 15, 753, 965	994, 444	406, 049	23, 284, 770
Total, 1926	5, 884, 568	3, 566, 212	4, 066, 913	[2] 14, 255, 911	1, 789, 437	811, 337	24, 489, 810

[1] Includes value of 189,554 pounds of copper saved from precipitates recovered from mine water, largely from leaching of ore in place.

[2] Includes value of 341,843 pounds of copper saved from precipitates recovered from mine water, largely from leaching of ore in place.

GOLD ORE

The gold ore and old tailings, largely dry and siliceous, were reported from 158 mines in Nevada in 1927, as compared with 139 in 1926, and yielded on the average $4.68 in gold and 0.96 ounce of silver to the ton, and a little copper and lead; the average value was $5.23 in metals a ton. Nye County had the largest number (27) of gold-ore producers; they reported 16,187 tons, mainly from the Round Mountain and Manhattan districts. Esmeralda County, with 22 producers of gold ore, made the greatest output—140,971 tons—most of which was old tailings from the Goldfield Consolidated dump; Storey County was second, with 81,667 tons. The largest producers of gold ore were the Goldfield Consolidated tailing dump at Goldfield, the Flowery property at Virginia City, the Elkoro mine at Jarbidge, the Comstock Merger property at Virginia City, and the Gold Circle Consolidated mine at Midas. Gold ore from Gilbert (Desert district), Esmeralda County, was hauled to the custom cyanidation mill at Millers.

GOLD AND SILVER ORE

Gold and silver ore and old tailings were reported from 17 mines in 8 counties in Nevada in 1927 and yielded on the average $4.98 in gold and 10.81 ounces of silver to the ton, and a little copper and lead. Six producers in Nye County reported the treatment of 2,205 tons of ore, nearly all of which came from the Bellehellen district. The Clifford mine at Bellehellen was the largest producer of gold and silver ore in the State. Nearly half of the total gold and silver material was old tailings from Cherry Creek, White Pine County, and Eldorado Canyon, Clark County.

SILVER ORE

Siliceous silver ore and old tailings were reported from 67 mines in Nevada in 1927. The output was 14,554 tons less than that in 1926, but the quantity of both gold and silver recovered increased. The average yield from this material was $2.56 in gold and 14.24

ounces of silver to the ton, and a little copper and lead, or an average value of $10.69 in metals a ton. The Tonopah district, in Nye and Esmeralda Counties, was the largest silver ore-producing district and was credited with 125,738 tons from 14 properties, compared with 127,252 tons from 12 properties in 1926. The largest silver ore-producing properties were the Tonopah Extension and the Tonopah Mining, both at Tonopah, the Rochester Silver at Rochester, the Consolidated Cortez at Cortez, and the Tonopah Belmont at Tonopah. A large quantity of old siliceous silver tailings was treated in a flotation mill at Dayton, Lyon County.

COPPER ORE

Copper ore was reported from 26 mines in Nevada in 1927. The ore, which decreased slightly in quantity, yielded on the average 20 cents in gold and 0.04 ounce of silver to the ton and 1.21 per cent of copper; its average value was $3.40 in metals a ton. The Nevada Consolidated Copper Co. in the Robinson district, White Pine County, was the chief producer, although the Consolidated Coppermines Corporation, whose property is in the same district, produced considerably more copper ore in 1927 than in 1926. A large quantity of copper ore was also produced from the property of the Mason Valley Mines Co. in the Yerington district, Lyon County.

LEAD ORE

Lead ore and slag were reported from 113 mines and prospects in Nevada in 1927, compared with 149 in 1926; the output decreased 32 per cent. The average yield of the ore and slag was $1.69 in gold and 18.51 ounces of silver to the ton, 0.12 per cent of copper, and 6.69 per cent of lead; the average value was $20.93 in metals a ton. Five properties—three in Eureka County, one in Lander County, and one in Nye County—yielded more than 80 per cent of the total lead ore from Nevada in 1927. The largest producers were the Betty O'Neal mine near Battle Mountain, Lander County, the Consolidated Cortez and Richmond-Eureka properties in Eureka County, the San Rafael mine in Nye County, and the Eureka-Holly mine in Eureka County.

COPPER-LEAD ORE

In 1927 the output of copper-lead ore from silver mines was more than double the output of 1926 and yielded on the average 34 cents in gold and 11.09 ounces of silver to the ton, 2.61 per cent of copper, and 5.07 per cent of lead; the average value was $19.87 in metals a ton. Nearly all the copper-lead ore was produced at the Bristol Silver mine near Pioche, Lincoln County.

ZINC ORE

Four mines in the Yellow Pine district, Clark County, produced 1,465 tons of zinc ore, which yielded on the average 31.30 per cent of zinc, or $40.06 in zinc a ton. Nearly all the zinc ore came from the Yellow Pine mine.

LEAD-ZINC ORE

Lead-zinc ore was reported from 16 mines in 8 counties in Nevada in 1927; the output was less than half that in 1926. The Yellow Pine district, Clark County, had the greatest number (eight) of producers, but the largest output came from the Combined Metals mine at Pioche, Lincoln County. Although the latter mine produced nearly 56 per cent of the total for the State, its output in 1927 was much less than that in 1926. The Simon Silver-Lead property at Simon, Mineral County, and the Yellow Pine property at Goodsprings, Clark County, also produced considerable lead-zinc ore. The lead-zinc ore yielded on the average 24 cents in gold and 3.87 ounces of silver to the ton, 0.08 per cent of copper, 5.22 per cent of lead, and 9.84 per cent of zinc; its average value was $21.82 in metals a ton.

Ore, old tailings, etc., sold or treated in Nevada in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	27	22.14	93			
Clark	41	134.41	58	5		
Douglas	20	18.38	24			
Elko	48,900	24,157.13	195,575	10	22	
Esmeralda	[1] 140,971	13,443.21	11,245	438	276	
Humboldt	169	164.58	66	45		
Lander	1,027	840.58	863	850		
Lincoln	26	25.00	400	54		
Lyon	[2] 2,190	980.14	4,124	153		
Mineral	730	1,105.16	2,139	1,146		
Nye	[3] 16,187	12,528.09	5,045	49	150	
Pershing	1,417	360.93	813			
Storey	[4] 81,667	11,378.41	61,272	1,100		
Washoe	250	358.44	146			
White Pine	686	1,098.65	749	836		
	294,308	66,615.25	282,612	4,686	448	
Total, 1926	141,967	51,699.25	89,327	6,263	2,186	

DRY GOLD AND SILVER ORE

Churchill	39	19.40	621			
Clark	[5] 800	78.75	2,148			
Esmeralda	119	48.19	1,524			
Lyon	[6] 5	1.82	44			
Mineral	510	380.52	17,665			
Nye	2,205	551.77	25,591	153		
Storey	143	22.54	642			
White Pine	[7] 1,448	166.00	8,749	7,137	65,000	
	5,269	1,268.99	56,984	7,290	65,000	
Total, 1926	433,749	50,090.77	1,569,164	3,853	989	

[1] Includes 136,000 tons of old tailings cyanided.
[2] Includes 800 tons of old tailings cyanided.
[3] Includes 100 tons of old tailings cyanided.
[4] Includes 1 ton of sweepings sold to a smelter and 3,000 tons of old tailings reconcentrated.
[5] Old tailings cyanided.
[6] Old tailings reconcentrated.
[7] Old tailings sold to a smelter.

Ore, old tailings, etc., sold or treated in Nevada in 1927, by counties, with content in terms of recovered metals—Continued

DRY SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	4	2.23	635			
Esmeralda	79,464	9,140.19	1,098,149			
Eureka	22,574	239.90	376,316	6,059	80,597	
Humboldt	[8] 271	3.78	3,448			
Lander	759	86.01	20,063	763	674	
Lincoln	699	6.28	8,624	1,188	27,451	
Lyon	[9] 32,000	667.09	36,344	13,939	3,486	
Mineral	325	195.32	16,373	6,110	1,093	
Nye	[10] 54,191	14,474.34	1,343,320	239	237	
Ormsby	8	.93	524	240		
Pershing	23,777	1,985.84	160,046	200	725	
Storey	17	.55	137			
Washoe	45	5.65	943			
White Pine	[11] 2,114	15.15	15,422	309		
	216,248	26,823.26	3,080,344	29,047	114,263	
Total, 1926	230,802	24,825.08	2,850,687	41,662	864,251	

COPPER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Elko	586	73.48	2,345	[12] 296,263		
Eureka	3	.03	314	533		
Lander	4,590	22.18	1,237	1,311,837		
Lincoln	522	9.06	3,681	78,045		
Lyon	392,805	10.86	14,154	9,504,355		
Mineral	260	19.36	2,837	36,143		
Nye	13	.14	28	2,386	18	
Washoe	4	5.32	484	420		
White Pine	4,486,269	46,743.53	158,445	107,437,471		
	4,885,052	46,883.96	183,525	[12] 118,667,453	18	
Total, 1926	4,888,681	36,408.95	142,316	[13] 100,870,898	1,417	

LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Churchill	298	16.58	5,729	443	142,859	
Clark	3,280	1,067.20	10,756	8,066	683,884	
Douglas	34	.34	1,198		13,075	
Elko	[14] 6,587	39.18	102,274	25,804	2,293,073	
Esmeralda	186	11.48	6,056	1,735	149,161	
Eureka	28,311	2,436.87	243,239	46,166	2,359,530	
Humboldt	80	2.48	7,290	550	5,854	
Lander	26,395	67.13	778,879	54,082	379,566	
Lincoln	159	14.00	3,003	682	127,255	
Mineral	672	431.86	63,218	3,697	130,445	
Nye	6,778	1,985.74	152,666	35,053	2,401,511	
Pershing	225	19.63	7,457	352	96,247	
Washoe	45	33.36	2,211		10,493	
White Pine	2,874	88.35	21,442	5,342	1,367,311	
	75,924	6,214.20	1,405,418	181,972	10,160,264	
Total, 1926	111,265	8,538.16	1,395,285	252,687	14,254,647	

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[8] Includes 250 tons of old tailings cyanided.

[9] Old tailings reconcentrated.

[10] Includes 150 tons of old tailings cyanided.

[11] Includes 1,960 tons of old tailings cyanided.

[12] Includes 189,551 pounds of copper saved from precipitates recovered from mine water, largely from leaching of ore in place.

[13] Includes 341,843 pounds of copper saved from precipitates recovered from mine water, largely from leaching of ore in place.

[14] Includes 1 ton of slag sold to a smelter.

Ore, old tailings, etc., sold or treated in Nevada in 1927, by counties, with content in terms of recovered metals—Continued

COPPER-LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Elko	41	0.69	1,360	3,417	13,028	
Lincoln	25,208	413.98	278,555	1,314,320	2,531,925	
Mineral	3	2.02	13	689	1,546	
White Pine	52	.20	785	4,878	18,103	
	25,304	416.89	280,713	1,323,304	2,564,602	
Total, 1926	10,151	203.51	147,470	594,800	1,285,217	

LEAD-ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Clark	5,883	6.01	2,881	1,808	1,006,559	2,628,970
Elko	165	1.12	926	1,835	66,305	40,197
Esmeralda	19	.48	84	79	2,800	3,142
Lander	75	3.87	866	105	22,256	20,510
Lincoln	15,387	294.52	85,849	40,413	1,251,405	2,438,395
Mineral	6,000	5.00	15,240	1,177	521,846	285,406
Washoe	4	.06	12		776	1,191
White Pine	49	3.33	985	107	8,276	9,604
	27,582	314.39	106,843	45,521	2,880,223	5,427,415
Total, 1926	67,641	749.79	322,613	57,774	5,944,788	10,624,065

Zinc ore, lead-zinc ore, and zinc concentrates (as marketed from Nevada mines and mills) sold to smelters in 1927

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized zinc ore	Clark	1,465	1,145,136	39.08	917,108
Oxidized lead-zinc ore	do	4,711	2,587,794	27.47	2,072,237
Zinc concentrates	Clark, Elko, Esmeralda, Lander, Lincoln, Mineral, Washoe, and White Pine.	3,892	3,911,540	50.25	3,355,178
		10,068	7,644,470	37.96	6,344,523

METALLURGIC INDUSTRY

The metal output of Nevada in 1927 came chiefly from the smelting of concentrates and first-class ore, but a large quantity of gold and silver was recovered by amalgamation and cyanidation. There was an increase of more than 11 per cent in the value of metals recovered from crude smelting ore and a slight increase from concentrates, but there was a decrease of nearly 36 per cent in yield from gold and silver mills.

Eighty milling plants in Nevada treated ore and old tailings in 1927. Of these, 32 used the amalgamation process, 20 concentration (11 used flotation, 3 tables and flotation, and 6 tables only), 17 cyanidation, 2 concentration and cyanidation, 1 amalgamation and cyanidation, 5 amalgamation and concentration, 2 amalgamation, cyanidation, and concentration, and 1 was a leaching plant where copper was recovered by precipitation largely from ore in place.

A list of the milling plants, with details of their equipment, in Nevada in 1925, prepared by the Bureau of Mines, may be had upon request.

About 605 pounds of quicksilver was purchased for amalgamation plants, and 1,105,600 pounds of sodium cyanide was used in cyanidation mills.

The output of milling ore and old tailings in 1927 was 5,330,625 tons, of which 322,530 tons of ore and 140,060 tons of old tailings were treated by amalgamation or cyanidation and 4,833,030 tons of ore and 35,005 tons of old tailings by concentration followed by smelting. The ore and old tailings treated by cyanidation (446,869 tons) yielded on the average $3.19 in gold and 6.77 ounces of silver to the ton. The ore amalgamated (15,721 tons) yielded bullion carrying 6,733.11 ounces of gold and 4,157 ounces of silver, or an average of $8.85 in gold and 0.26 ounce of silver to the ton of ore. Of the total ore and other material 88 per cent was of concentrating grade and produced concentrates which, with those from gold and silver mills, yielded on the average $50.83 in metals a ton.

Of the ore of smelting grade, which was nearly 4 per cent of the total quantity of ore and other material mined or treated, 65 per cent was first-class copper ore and the remainder was mainly copper-lead ore, lead ore, and dry and siliceous ore. The quantity of copper ore smelted decreased slightly in 1927; more than 87 per cent of it was oxidized. The quantity of copper-lead ore of smelting grade, nearly all of which was oxidized, increased from 10,151 to 25,304 tons. The quantity of lead ore of smelting grade, more than half of which was oxidized, decreased 28 per cent in 1927. The quantity of lead-zinc ore smelted increased from 3,049 to 4,711 tons.

The miscellaneous material, other than ore and old tailings milled and crude ore smelted, was not important. It consisted of precipitates and of 1,450 tons of old tailings, slag, and assay office sweepings smelted and yielded 181.55 ounces of gold, 8,806 ounces of silver, 196,713 pounds of copper, and 65,097 pounds of lead.

Mine production of metals from gold and silver mills in Nevada in 1927, by counties

County	Ore and old tailings treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Churchill	8		2.29	6		
Clark	38	800	29.15	14	78.75	2,148
Douglas	15		11.19	6		
Elko	48,899		587.93	391	23,556.31	195,157
Esmeralda	81,647	136,000	211.71	82	18,048.90	1,090,981
Eureka	22,574				183.17	226,412
Humboldt	135	250	101.48	41	3.73	2,171
Lander	465		238.01	62	64.01	18
Lyon	664	800	344.77	337	132.59	324
Mineral	68		54.64	31		
Nye	64,145	250	3,777.25	2,219	14,731.85	1,292,411
Pershing	25,131		283.30	323	1,972.00	156,356
Storey	78,266		656.18	478	10,221.41	52,763
Washoe	250		358.44	146		
White Pine	225	1,960	76.77	21	1.43	6,202
	322,530	140,060	6,733.11	4,157	68,994.15	3,024,943
Total, 1926	744,900	4,060	9,297.27	6,328	109,124.92	4,269,460

Mine production of metals from gold and silver mills in Nevada in 1927, by counties—Continued

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Elko	2	7.29	8	10	22
Esmeralda	8	61.44	715		276
Eureka	522	56.73	149,904	6,059	80,597
Pershing	8	22.05	217		
Storey	23	41.84	62		
	563	189.35	150,906	6,069	80,895
Total, 1926	386	236.46	46,573	1,837	35,494

Mine production of metals from concentrating mills in Nevada in 1927, by counties

County	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Clark	4,076		1,058	765.45	10,075	7,384	450,073	556,733
Elko	3,015		590	5.21	31,414	2,907	552,182	40,197
Esmeralda	19		8	.48	84	79	2,800	3,142
Eureka	20,514		1,404	138.30	181,845	8,416	709,166	
Humboldt	75		18	1.45	7,076	550	2,101	
Lander	27,289		1,826	429.19	776,530	53,885	337,186	20,510
Lincoln	15,387		4,130	294.52	85,849	40,413	1,251,405	2,438,395
Lyon	378,921	32,005	36,119	668.91	50,212	9,044,660	3,486	
Mineral	6,200		840	6.32	32,471	2,389	542,702	285,406
Nye	110		30	3.51	3,209	59	4,773	
Storey		3,000	37	168.08	2,914	1,100		
Washoe	4		2	.06	12		776	1,191
White Pine	4,377,420		280,378	44,952.96	155,030	100,163,295	147,439	9,604
	4,833,030	35,005	326,440	47,434.44	1,336,721	109,325,137	4,004,089	3,355,178
Total, 1926	4,901,878	37,155	446,788	39,240.66	1,431,964	93,576,893	9,653,047	9,024,733

Mine production of metals from Nevada concentrates in 1927

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Clark	1,058	765.45	10,075	7,384	450,073	556,733
Elko	592	12.50	31,422	2,917	552,204	40,197
Esmeralda	16	61.92	799	79	3,076	3,142
Eureka	1,926	195.03	331,749	14,475	789,763	
Humboldt	18	1.45	7,076	550	2,101	
Lander	1,826	429.19	776,530	53,885	337,186	20,510
Lincoln	4,130	294.52	85,849	40,413	1,251,405	2,438,395
Lyon	36,119	668.91	50,212	9,044,660	3,486	
Mineral	840	6.32	32,471	2,389	542,702	285,406
Nye	30	3.51	3,209	59	4,773	
Pershing	8	22.05	217			
Storey	60	209.92	2,976	1,100		
Washoe	2	.06	12		776	1,191
White Pine	280,378	44,952.96	155,030	100,163,295	147,439	9,604
	327,003	47,623.79	1,487,627	109,331,206	4,084,984	3,355,178
Total, 1926	447,174	39,477.12	1,478,537	93,578,730	9,688,541	9,024,733

Mine production of metals from Nevada concentrates in 1927—Continued

BY KINDS OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	934	1,332.51	41,749	15,868	4,458	------
Copper	315,630	44,943.29	165,667	109,193,609	------	------
Lead	6,547	1,284.17	1,259,261	91,288	3,959,709	------
Zinc	3,892	63.82	20,950	30,441	120,817	3,355,178

Mine production of metals from Nevada crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	360	58.06	7,072	443	142,859	------
Clark	6,555	413.02	3,606	2,495	1,240,370	2,989,345
Douglas	39	7.53	1,216	------	13,075	------
Elko	4,364	114.66	75,498	134,836	1,820,127	------
Esmeralda	3,093	4,321.02	25,196	2,173	149,161	------
Eureka	7,800	2,298.60	61,708	38,283	1,650,364	------
Humboldt	60	64.18	1,516	45	3,753	------
Lander	5,092	288.55	25,298	1,313,752	65,310	------
Lincoln	26,614	468.32	294,263	1,394,289	2,686,631	------
Lyon	14,610	513.64	3,793	473,787	------	------
Mineral	2,232	2,078.28	84,983	46,573	112,228	------
Nye	14,869	11,027.47	228,811	37,821	2,397,143	------
Ormsby	8	.93	524	240	------	------
Pershing	288	89.05	11,420	552	96,972	------
Storey	560	298.65	5,789	------	------	------
Washoe	94	44.33	3,638	420	10,493	------
White Pine	112,439	2,918.05	36,575	7,285,648	1,246,251	------
	199,077	25,004.34	870,906	10,731,357	11,634,737	2,989,345
Total, 1926	194,780	14,558.85	751,219	7,885,134	12,348,201	1,793,100

BY KINDS OF ORE

Dry and siliceous	15,831	17,409.66	190,393	11,959	29,656	------
Copper	129,836	1,940.67	17,858	9,284,290	18	------
Lead	21,930	5,237.12	381,942	111,804	8,076,742	------
Zinc	1,465	------	------	------	------	917,108
Copper-lead	25,304	416.89	280,713	1,323,304	2,564,602	------
Lead-zinc	4,711	------	------	------	963,719	2,072,237

REVIEW BY COUNTIES AND DISTRICTS

Previous issues of this annual report on metal mining in Nevada have reviewed the statistics of gold, silver, copper, lead, and zinc production and recorded significant details of mining and metallurgic activities by counties and for most of the mining districts. Long-continued shortage of personnel in the division of mineral statistics, of the Bureau of Mines, has so delayed the preparation of the report that the review is omitted except for the following tabular statements relating to important mining districts.

Mine production of gold, silver, copper, and lead in the Tonopah district, Esmeralda and Nye Counties, Nev., 1926–27, and total, 1904–1927

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1926	12	127,252	$454,067	2,052,956	62		$1,735,120
1927	15	125,790	460,044	2,167,694			1,689,127
Total, 1904–1927		7,889,941	34,134,719	155,840,652	12,175	214,523	133,989,543

Mine production of gold, silver, copper, lead, and zinc in the Robinson district, White Pine County, Nev., 1926–27, and total, 1904–1927

Year	Mines producing	Ore	Gold	Silver	Copper[1]	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1926	7	4,672,240	$751,863	144,092	95,009,115	363,428	51,900	$14,176,018
1927	12	4,488,009	988,090	179,708	107,440,936	593,066	9,604	15,202,725
Total, 1904–1927		58,039,996	10,059,329	1,762,885	1,286,761,135	4,474,441	6,070,025	229,608,336

[1] Includes copper saved from precipitates recovered from mine water.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

The total calculated gross value of the recovered and estimated recoverable gold, silver, copper, lead, and zinc from gravels handled and ores mined in Colorado in 1927 showed a decrease of 19 per cent from the gross value in 1926, following an increase in 1926 of less than 1 per cent over the gross value in 1925. There were appreciable increases in quantity in 1927 for copper and zinc but decreases for gold, silver, and lead. There were 330 lode mines and 19 placers producing in 1927 compared with 387 lode mines and 31 placers in 1926, or a decrease of 57 lode mines and 12 placers.

The total recorded value of gold, silver, copper, lead, and zinc (in terms of recovered metals) produced from Colorado ores and gravels from 1858 to 1927, inclusive, is $1,608,323,176.[1]

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

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[1] For details 1858 to 1923, see Henderson, Chas. W., Mining in Colorado: U. S. Geol. Survey Prof. Paper 138, 1926, 263 pp.; for recapitulation by years 1858 to 1925 see Gold, Silver, Copper, Lead, and Zinc in Colorado: Mineral Resources of the United States, 1925, Pt. I, opp. p. 701.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1918–1927

Year	Mines producing			Ore sold or treated (short tons)	Gold			Silver (lode and placer)	
	Lode	Placer	Total		Lode	Placer	Total	Fine ounces	Value
1918	576	12	588	2, 314, 890	$12, 225, 516	$526, 202	$12, 751, 718	7, 063, 554	$7, 063, 554
1919	453	11	464	1, 919, 768	9, 336, 065	550, 562	9, 886, 627	5, 758, 010	6, 448, 971
1920	405	11	416	1, 571, 293	7, 061, 731	514, 588	7, 576, 319	5, 409, 335	5, 896, 175
1921	367	15	382	1, 281, 381	6, 490, 688	344, 640	6, 835, 328	5, 631, 657	5, 631, 657
1922	460	20	480	1, 412, 100	6, 017, 016	356, 403	6, 373, 419	5, 855, 911	5, 855, 911
1923	400	17	417	1, 569, 100	6, 227, 200	364, 429	6, 591, 629	5, 334, 488	4, 374, 280
1924	340	18	358	1, 514, 182	8, 174, 610	418, 506	8, 593, 116	3, 254, 370	2, 180, 428
1925	412	30	442	1, 745, 674	7, 076, 704	150, 318	7, 227, 022	4, 506, 940	3, 127, 816
1926	387	31	418	1, 839, 740	7, 031, 079	46, 954	7, 078, 033	4, 704, 122	2, 935, 372
1927	330	19	349	1, 606, 528	5, 184, 684	94, 434	5, 279, 118	3, 784, 605	2, 145, 871

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	6, 277, 332	$1, 550, 501	65, 960, 760	$4, 683, 214	89, 133, 901	$8, 111, 185	$34, 160, 172
1919	3, 560, 207	662. 198	37, 070, 241	1, 964, 722	37, 220, 493	2, 717, 096	21, 679, 614
1920	4, 043, 734	744, 047	46, 629, 788	3, 730, 383	48, 790, 742	3, 952, 050	21, 898, 974
1921	4, 153, 442	535, 794	19, 660, 466	884, 721	2, 360, 000	118, 000	14, 005, 500
1922	3, 373, 454	455, 416	23, 477, 200	1, 291, 246	23, 258, 000	1, 325, 706	15, 301, 698
1923	4, 248, 109	624, 472	45, 698, 185	3, 198, 873	54, 152, 000	3, 682, 336	18, 471, 590
1924	2, 713, 219	355, 432	47, 557, 061	3, 804, 565	56, 727, 000	3, 687, 255	18, 620, 796
1925	2, 360, 500	335, 191	62, 966, 000	5, 478, 042	61, 621, 000	4, 683, 196	20, 851, 267
1926	3, 403, 850	476, 539	68, 987, 800	5, 519, 024	65, 000, 000	4, 875, 000	20, 883, 968
1927	5, 670, 581	742, 846	66, 772, 557	4, 206, 671	71, 729, 000	4, 590, 656	16, 965, 162

Gold and silver produced at placer mines in Colorado, 1918–1927, in fine ounces

Year	Sluicing and hydraulic		Dredging		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
1918	158. 72	8	25, 296. 30	6, 642	25, 455. 02	6, 650
1919	409. 18	87	26, 224. 26	7, 056	26, 633. 44	7, 143
1920	82. 81	22	24, 810. 39	6, 694	24, 893. 20	6, 716
1921	323. 63	96	16, 348. 32	4, 346	16, 671. 95	4, 442
1922	487. 43	128	16, 753. 57	4, 100	17, 241. 00	4, 228
1923	269. 22	66	17, 360. 03	4, 056	17, 629. 25	4, 122
1924	310. 85	81	19, 934. 38	4, 873	20, 245. 23	4, 954
1925	445. 77	101	6, 825. 86	1, 798	7, 271. 63	1, 899
1926	391. 54	67	1, 879. 86	502	2, 271. 40	569
1927	364. 38	73	4, 203. 87	1, 063	4, 568. 25	1, 136

GOLD

The mine production of gold in Colorado in 1927 was 255,377.33 fine ounces, valued at $5,279,118, a decrease from 1926 of 87,022.51 fine ounces and of $1,798,915.

The Cripple Creek district contributed $3,307,505, or 63 per cent, of this total yield. That part of the San Juan region including Dolores, La Plata, Ouray, San Juan, and San Miguel Counties yielded $1,234,430, a decrease of $475,822. The largest increases were $56,106 in Summit County, $27,731 in Rio Grande, $16,631 in La Plata, and $14,521 in Saguache. The largest decreases were $1,128,507 in Teller County, $437,431 in San Miguel, $222,071 in Lake, $42,861 in San Juan, $26,694 in Boulder, $24,844 in Clear Creek, $16,747 in Ouray, and $13,911 in Gilpin.

The output of placer gold in 1927 was $94,434, an increase of $47,480. Summit County, with 1 dredge, 1 hydraulic, and 5 sluice mines, produced 94 per cent of the placer gold. The other counties producing placer gold in 1927 were Adams, Chaffee, Clear Creek, Gilpin, Moffat, Montrose, and Park.

SILVER

The mine production of silver in Colorado in 1927 was 3,784,605 fine ounces, valued at $2,145,871, a decrease of $789,501 from 1926. The largest increases were $298,489 in Saguache County, $40,882 in Dolores, and $3,380 in La Plata. The largest decreases were $239,044 in San Miguel County, $222,296 in Mineral, $212,597 in Lake, $149,237 in Clear Creek, $131,050 in San Juan, and $64,819 in Pitkin.

COPPER

The mine production of copper in Colorado in 1927 was 5,670,581 pounds, valued at $742,846, an increase of $266,307 over 1926. Saguache County produced nearly 60 per cent of the copper output, San Juan 27 per cent, San Miguel 4 per cent, Lake 3 per cent, Dolores 2 per cent, Eagle nearly 2 per cent, and Ouray nearly 2 per cent. The combined output of the 10 other counties producing in 1927 was less than 1 per cent of the total.

LEAD

The mine production of lead in Colorado in 1927, reckoned as lead in lead bullion and in leaded zinc oxide, was 66,772,557 pounds, valued at $4,206,671, a decrease of $1,312,353 from 1926. With the exception of Dolores, Eagle, and Saguache Counties, in which notable increases were recorded in both quantity and value, all the important lead-producing counties decreased in output in 1927.

ZINC

The zinc-bearing ores marketed from Colorado in 1927 contained 71,729,000 pounds of recoverable zinc, valued at $4,590,656, an increase of 6,729,000 pounds but a decrease of $284,344 from 1926. Lake County led in zinc production in 1927 with 23,690,000 pounds, 33 per cent of the zinc output of the State, compared with 34.3 per cent in 1926. San Juan ranked second in 1927 and produced 22,869,000 pounds, 32 per cent of the total, compared with 34.5 per cent in 1926. Other of the larger zinc-producing counties, in order of output in 1927, were Dolores, Eagle, Summit, San Miguel, Gunnison, Pitkin, and Ouray.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1927, by counties

County	Mines producing			Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total	Fine ounces	Value	Fine ounces	Value
Adams	--------	2	2	161.57	$3,340	23	$13
Boulder	33	--------	33	4,265.86	88,183	41,598	23,586
Chaffee	5	1	6	18.92	391	2,035	1,154
Clear Creek	51	1	52	3,059.04	63,236	36,681	20,798
Custer	4	--------	4	.48	10	342	194
Dolores	13	--------	13	410.61	8,488	173,395	98,315
Eagle	5	--------	5	382.64	7,910	85,741	48,615
Fremont	1	--------	1	1.31	27	136	77
Garfield	1	--------	1	.53	11	194	110
Gilpin	26	3	29	1,373.76	28,398	7,621	4,321
Gunnison	7	--------	7	201.14	4,158	19,739	11,192
Hinsdale	8	--------	8	34.59	715	3,446	1,954
Lake	39	--------	39	11,977.99	247,607	411,471	233,304
La Plata	2	--------	2	1,117.61	23,103	8,912	5,053
Mesa	1	--------	1	--------	--------	81	46
Mineral	4	--------	4	11.90	246	214,850	121,820
Moffat	--------	2	2	23.03	476	--------	--------
Montrose	--------	2	2	4.45	92	2	1
Ouray	14	--------	14	1,311.26	27,106	79,291	44,958
Park	9	1	10	1,921.41	39,719	3,913	2,219
Pitkin	10	--------	10	--------	--------	152,328	86,370
Rio Grande	1	--------	1	6,459.51	133,530	268	152
Saguache	12	--------	12	968.08	20,012	845,044	479,140
San Juan	10	--------	10	12,235.35	252,927	726,291	411,807
San Miguel	12	--------	12	44,640.74	922,806	905,949	513,673
Summit	12	7	19	4,795.03	99,122	39,910	22,629
Teller	50	--------	50	160,000.52	3,307,505	25,344	14,370
	330	19	349	255,377.33	5,279,118	3,784,605	2,145,871
Total, 1926	387	31	418	342,399.84	7,078,033	4,704,122	2,935,372

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams	--------	--------	--------	--------	--------	--------	$3,353
Boulder	3,436	$450	167,288	$10,539	--------	--------	122,758
Chaffee	--------	--------	68,700	4,328	47,000	$3,008	8,881
Clear Creek	17,809	2,333	243,939	15,368	--------	--------	101,735
Custer	99	13	683,983	43,091	--------	--------	43,308
Dolores	131,000	17,161	9,987,777	629,230	10,615,000	679,360	1,432,554
Eagle	89,000	11,659	4,117,000	259,371	7,800,000	499,200	826,755
Fremont	801	105	2,492	157	--------	--------	366
Garfield	--------	--------	10,142	639	--------	--------	760
Gilpin	8,710	1,141	92,635	5,836	--------	--------	39,696
Gunnison	3,481	456	691,682	43,576	455,000	29,120	88,502
Hinsdale	2,596	340	155,285	9,783	44,000	2,816	15,608
Lake	172,450	22,591	13,562,762	854,454	23,690,000	1,516,160	2,874,116
La Plata	--------	--------	--------	--------	--------	--------	28,156
Mesa	893	117	--------	--------	--------	--------	163
Mineral	--------	--------	75,286	4,743	--------	--------	126,809
Moffat	--------	--------	--------	--------	--------	--------	476
Montrose	--------	--------	--------	--------	--------	--------	93
Ouray	85,710	11,228	290,713	18,315	93,000	5,952	107,559
Park	3,298	432	39,477	2,487	--------	--------	44,857
Pitkin	--------	--------	2,406,888	151,634	200,000	12,800	250,804
Rio Grande	--------	--------	--------	--------	--------	--------	133,682
Saguache	3,378,504	442,584	6,030,222	379,904	--------	--------	1,321,640
San Juan	1,549,214	202,947	17,271,016	1,088,074	22,869,000	1,463,616	3,419,371
San Miguel	219,443	28,747	9,647,540	607,795	708,000	45,312	2,118,333
Summit	4,137	542	1,227,730	77,347	5,208,000	333,312	532,952
Teller	--------	--------	--------	--------	--------	--------	3,321,875
	5,670,581	742,846	66,772,557	4,206,671	71,729,000	4,590,656	16,965,162
Total, 1926	3,403,850	476,539	68,987,800	5,519,024	65,000,000	4,875,000	20,883,968

Gold and silver produced at lode and placer mines in Colorado in 1927, by counties

County	Lode mines					Placer mines				Grand total value
	Ore sold or treated	Gold	Silver		Total value	Gold	Silver		Total value	
	Short tons		*Fine ounces*				*Fine ounces*			
Adams						$3,340	23	$13	$3,353	$3,353
Boulder	21,867	$88,183	41,598	$23,586	$111,769					111,769
Chaffee	318	271	2,035	1,154	1,425	120			120	1,545
Clear Creek	8,655	63,061	36,679	20,797	83,858	175	2	1	176	84,034
Custer	36,089	10	342	194	204					204
Dolores	60,743	8,488	173,395	98,315	106,803					106,803
Eagle	57,811	7,910	85,741	48,615	56,525					56,525
Fremont	26	27	136	77	104					104
Garfield	66	11	194	110	121					121
Gilpin	3,865	27,503	7,612	4,316	31,819	895	9	5	900	32,719
Gunnison	1,967	4,158	19,739	11,192	15,350					15,350
Hinsdale	378	715	3,446	1,954	2,669					2,669
Lake	141,075	247,607	411,471	233,304	480,911					480,911
La Plata	613	23,103	8,912	5,053	28,156					28,156
Mesa	1		81	46	46					46
Mineral	3,592	246	214,850	121,820	122,066					122,066
Moffat						476			476	476
Montrose						92	2	1	93	93
Ouray	12,682	27,106	79,291	44,958	72,064					72,064
Park	1,928	39,420	3,908	2,216	41,636	299	5	3	302	41,938
Pitkin	23,525		152,328	86,370	86,370					86,370
Rio Grande	137	133,530	268	152	133,682					133,682
Saguache	112,515	20,012	845,044	479,140	499,152					499,152
San Juan	282,824	252,927	726,291	411,807	664,734					664,734
San Miguel	312,490	922,806	905,949	513,673	1,436,479					1,436,479
Summit	34,411	10,085	38,815	22,008	32,093	89,037	1,095	621	89,658	121,751
Teller	488,950	3,307,505	25,344	14,370	3,321,875					3,321,875
	1,606,528	5,184,684	3,783,469	2,145,227	7,329,911	94,434	1,136	644	95,078	7,424,989
Total, 1926	1,839,740	7,031,079	4,703,553	2,935,017	9,966,096	46,954	569	355	47,309	10,013,405

Gold and silver produced at placer mines in Colorado in 1927, by counties, in fine ounces

County	Sluicing and hydraulic		Dredging		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Adams	161.57	23			161.57	23
Chaffee	5.81				5.81	
Clear Creek	8.46	2			8.46	2
Gilpin	43.29	9			43.29	9
Moffat	23.03				23.03	
Montrose	4.45	2			4.45	2
Park	14.47	5			14.47	5
Summit	103.30	32	4,203.87	1,063	4,307.17	1,095
	364.38	73	4,203.87	1,063	4,568.25	1,136
Total, 1926	391.54	67	1,879.86	502	2,271.40	569

MINING INDUSTRY

The outstanding features of 1927 in the metal-mining industry of Colorado were: The gross calculated value of the recoverable gold, silver, copper, lead, and zinc decreased 19 per cent as compared with 1926; the yields of zinc and copper in 1927 showed increases in quantity, but the decrease of $0.011 in average price per pound of zinc caused a decrease of $284,344 in total calculated value, and the decrease of $0.009 in average price of copper limited the increase in total calculated value to $266,307; the lead yield fell off only 2,215,243 pounds, but the decrease of $0.017 in average price resulted in a decrease of $1,312,353 in total calculated value; a decrease of 919,517 ounces in silver output, coupled with a decrease of $0.057 in average price per ounce, resulted in a total value decrease of $789,501; gold showed the heaviest decrease, $1,798,915, of which $1,788,000 was due to decreases of $1,128,507 in the Cripple Creek district, $437,431 in San Miguel County, and $222,071 in Lake County, and the remainder to the overbalancing of increases in Summit, Rio Grande, La Plata, Saguache, Dolores, and Park Counties by decreases in San Juan, Boulder, Clear Creek, Ouray, Gilpin, Eagle, and Chaffee Counties; the decreases in silver yield in San Miguel, Mineral, Lake, Clear Creek, San Juan, and Pitkin Counties were not compensated by the increases in Saguache, Dolores, and La Plata Counties; the copper increase is mainly attributable to the increased output of lead-copper-silver-gold concentrates from the Rawley mine, Saguache County; the notable increases in lead production in Dolores, Eagle, and Saguache Counties were more than balanced by decreases in the other important lead-producing counties; the zinc increase is largely due to the increased yield from Rico, Dolores County.

Operating details are given under the caption, "Review by counties and districts." Some of the more significant are briefly noted in the following: In the Cripple Creek district the tonnage of ore mined from the Cresson for the calendar year was slightly greater than in 1926 but the grade of the ore shipped was under that of 1926, the Portland production was about $800,000 less than that of 1926, the Vindicator surface buildings were destroyed by fire in December, the Queen was reopened, and the United Gold Mines Co. increased its output from 90,861 tons of ore in 1926 to 93,840 tons in 1927. At Colorado Springs the Golden Cycle mill was operated continuously, mainly on Cripple Creek mine and dump ore. At Canon City the Empire Zinc Co.'s magnetic mill was abandoned shortly after the end of the year. At Florence the River matting, fuming, and zinc oxide plant made a short run on ore and concentrates in stock but purchased no new ore. At Ilse high-grade lead (cerussite) concentrates were produced from the Terrible mine until October. At Bonanza the Rawley mill continued in operation at a rate of 300 to 325 tons of ore a day. In the Summitville district the Little Annie mine produced $133,530 in gold. At Creede silver production decreased. At Eureka the Sunnyside selective flotation mill operated steadily at a rate of 825 tons of ore a day. Near Silverton development work was done at the Shenandoah-Dives-Mayflower-North Star group. At Rico the International selective flotation 225-ton mill operated for nine months. At Ophir the Carbonero and San Bernardo selective flotation mills were in operation. At Telluride the Smuggler Union was the only important producer. In Ouray County the operations at the Camp Bird upper levels were continued by lessees; the Sutton flotation mill and the Wanakah concentration mill were operated part time; copper ore was shipped from the San Antonio, copper-lead-zinc ore from the Beaver-Belfast, and lead-silver-gold ore from the Bachelor; and development work was done on the Wanakah-Pony Express-American Nettie-Jonathan group. At Aspen silver and lead output decreased. At Rifle the 110 to 140 ton vanadium plant operated steadily. At Gilman zinc-lead-silver-gold-iron ore was shipped until October and silver-iron pyrite throughout the year, while development of ore reserves was continued. In the Leadville district 62 per cent of the tonnage mined was lead-zinc-silver-iron ore (mostly from the Leadville Deep Mines) which was shipped to the Colorado Zinc-Lead selective flotation mill and to zinc-lead pigment plants, and 18 per cent was old smelter slags; the tonnage of all classes of ore available for the Leadville smelter was only sufficient for two furnaces. At Climax the Climax Molybdenum Co.'s flotation mill was operated at an average rate of 578 tons of ore a day for 365 days. In Summit County at Montezuma two mills were operated part time; at Breckenridge the Wellington wet gravity and roast magnetic mill was changed to a selective flotation mill, the pilot mill of the Royal Tiger was operated part time, and the Blue River dredge was operated from May 1 to December 31. In Park County operations comprised, chiefly, development work; the Fairplay dredge remained idle; some gold-silver-copper-lead-bismuth ores were shipped from Hall Valley. In Boulder County the Boulder County and Wood Mountain mills were in operation; the Wolf Tongue tungsten mill was destroyed by fire early in the summer, but a new mill was built and was ready for work in December. In the Silver Plume-Georgetown district the East Butte mill was idle and there was only small production from the mines of the district. At Empire the Gold Dirt or Rose City No. 2 flotation mill was operated on pyritic gold ore from the Gold Dirt mine. At Idaho Springs there was continued production of telluride ore from the West Gold but in lessened quantity; the Newton mill was operated for only a short period; the Lake property was developed through the Big Five lateral; and the Argo adit was reopened to allow development of the Concrete and Burroughs group in the adjoining (Gilpin) county. In Gilpin County the Eureka, Incidental, Pewabic, Arizona-Morning Star, and Perigo mines were the chief producers; the Rose City No. 1 mill was destroyed by fire.

ORE CLASSIFICATION

Ore sold or treated in Colorado in 1927, with content in terms of recovered metals

Source	Ore		Gold		Silver	
	Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	514,376	32.02	183,017.90	71.67	67,791	1.79
Dry gold and silver ore	299,099	18.62	49,292.08	19.30	735,964	19.45
Dry silver ore	221,830	13.81	2,359.52	.92	1,605,746	42.43
	1,035,305	64.45	234,669.50	91.89	2,409,501	63.67
Copper ore	467	.03	140.61	.06	14,888	.39
Copper-lead ore	410	.03	87.61	.03	8,284	.22
Lead ore	61,275	3.81	2,495.90	.98	244,788	6.47
Lead-zinc ore	508,679	31.66	13,415.46	5.25	1,106,008	29.22
Zinc ore	392	.02				
	571,223	35.55	16,139.58	6.32	1,373,968	36.30
Total, lode mines	1,606,528	100.00	250,809.08	98.21	3,783,469	99.97
Total, placers			4,568.25	1.79	1,136	.03
	1,606,528	100.00	255,377.33	100.00	3,784,605	100.00
Total, 1926	1,839,740		342,399.84		4,704,122	

Ore sold or treated in Colorado in 1927, with content in terms of recovered metals—Con.

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	39,619	0.70	266,609	0.40	----------	----------
Dry gold and silver ore	127,778	2.25	6,461,097	9.68	456,000	0.64
Dry silver ore	3,626,145	63.95	12,188,505	18.25	----------	----------
	3,793,542	66.90	18,916,211	28.33	456,000	.64
Copper ore	54,313	.96	10,048	.02	----------	----------
Copper-lead ore	43,466	.77	134,940	.20	----------	----------
Lead ore	40,502	.71	7,000,535	10.48	----------	----------
Lead-zinc ore	1,738,758	30.66	40,710,823	60.97	71,131,000	99.17
Zinc ore	----------	----------	----------	----------	142,000	.19
	1,877,039	33.10	47,856,346	71.67	71,273,000	99.36
	5,670,581	100.00	66,772,557	100.00	71,729,000	100.00
Total, 1926	3,403,850	----------	68,987,800	----------	65,000,000	----------

Ore sold or treated in Colorado in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	810	1,161.05	1,154	1,031	165	----------
Clear Creek	6,644	2,803.79	7,773	9,854	53,078	----------
Gilpin	3,589	1,158.28	3,112	4,786	35,303	----------
Gunnison	215	166.87	574	----------	952	----------
Lake	9,116	8,293.18	25,043	18,427	142,000	----------
Ouray	3,045	1,089.76	3,440	5,384	12,302	----------
Park	1,868	1,858.44	1,057	137	22,809	----------
Rio Grande	137	6,459.51	268	----------	----------	----------
San Miguel	2	26.50	26	----------	----------	----------
Teller	488,950	160,000.52	25,344	----------	----------	----------
	514,376	183,017.90	67,791	39,619	266,609	----------
Total, 1926	519,892	249,199.78	63,597	25,486	276,798	----------
DRY GOLD AND SILVER ORE						
Boulder	21,001	3,079.35	40,046	1,153	145,487	----------
Clear Creek	698	103.34	3,724	4,078	17,741	----------
Eagle	56	53.01	1,371	200	----------	----------
Gilpin	21	8.16	150	827	----------	----------
Lake	1,808	1,599.30	35,985	65,093	76,000	----------
La Plata	613	1,117.61	8,912	----------	----------	----------
Ouray	500	29.52	923	----------	26,735	----------
San Juan	218	25.80	585	638	15,890	----------
San Miguel	265,686	42,975.68	637,390	54,904	6,143,430	456,000
Summit	8,498	300.31	6,878	885	35,814	----------
	299,099	49,292.08	735,964	127,778	6,461,097	456,000
Total, 1926	482,361	70,227.48	1,005,660	177,783	7,553,239	----------
DRY SILVER ORE						
Clear Creek	690	13.31	9,227	----------	26,282	----------
Custer	8	.28	165	99	----------	----------
Eagle	4,951	232.40	51,193	88,800	200	----------
Gilpin	60	4.70	955	----------	4,241	----------
Lake	26,903	220.90	88,777	31,226	1,644,000	----------
Mineral	3,592	11.90	214,850	----------	75,286	----------
Ouray	8,052	141.05	44,116	34,181	----------	----------
Park	6	----------	13	----------	335	----------
Pitkin	18,978	----------	113,008	----------	1,669,122	----------
Saguache	112,402	967.48	843,019	3,378,236	6,000,128	----------
San Miguel	44,783	758.70	232,892	90,351	2,735,111	----------
Summit	1,405	8.80	7,531	3,252	33,800	----------
	221,830	2,359.52	1,605,746	3,626,145	12,188,505	----------
Total, 1926	237,942	1,550.08	1,729,130	1,116,700	10,426,210	----------

Ore sold or treated in Colorado in 1927, by counties, with content in terms of recovered metals—Continued

COPPER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Lake	342	85.00	11,301	38,417	6,000	
Mesa	1	------	81	893	------	------
Ouray	101	8.01	1,619	13,140	3,191	------
Park	23	47.60	1,887	1,863	857	------
	467	140.61	14,888	54,313	10,048	------
Total, 1926	2,126	688.99	43,312	315,152	32,359	------

COPPER-LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Boulder	14	.83	200	1,252	11,156	------
Clear Creek	4	------	300	489	1,429	------
Ouray	183	22.36	1,157	27,469	35,291	------
Park	17	.70	774	1,298	3,571	------
San Juan	192	63.72	5,853	12,958	83,493	------
	410	87.61	8,284	43,466	134,940	------
Total, 1926	97	23.32	2,628	8,126	24,219	------

LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Boulder	42	24.63	198	------	10,480	------
Chaffee	237	13.11	2,035	------	68,700	------
Clear Creek	619	130.14	15,655	3,388	145,409	------
Custer	36,081	.20	177	------	683,983	------
Dolores	1,801	57.70	16,038	9,000	783,777	------
Fremont	26	1.31	136	801	2,492	------
Garfield	66	.53	194	------	10,142	------
Gilpin	195	159.33	3,395	3,097	53,091	------
Gunnison	463	25.28	7,784	1,033	283,200	------
Hinsdale	268	22.47	2,946	803	125,637	------
Lake	15,639	1,329.70	90,291	5,287	3,430,000	------
Ouray	399	18.12	27,225	1,112	120,135	------
Park	14	.20	177	------	11,905	------
Pitkin	4,179	------	33,941	------	615,878	------
Saguache	113	.60	2,025	268	30,094	------
San Juan	80	14.03	10,313	2,225	36,996	------
San Miguel	724	646.04	26,773	13,488	427,805	------
Summit	329	52.51	5,485	------	160,811	------
	61,275	2,495.90	244,788	40,502	7,000,535	------
Total, 1926	93,531	1,997.82	626,986	30,333	11,734,527	------

LEAD-ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Dolores	58,942	352.91	157,357	122,000	9,204,000	10,615,000
Eagle	52,804	97.23	33,177	------	4,116,800	7,800,000
Gunnison	1,289	8.99	11,381	2,448	407,530	455,000
Hinsdale	110	12.12	500	1,793	29,648	44,000
Lake	86,956	449.91	160,074	14,000	8,264,762	23,595,000
Ouray	402	2.44	811	4,424	93,059	93,000
Pitkin	368	------	5,379	------	121,888	200,000
San Juan	282,334	12,131.80	709,540	1,533,393	17,134,637	22,869,000
San Miguel	1,295	233.82	8,868	60,700	341,194	252,000
Summit	24,179	126.24	18,921	------	997,305	5,208,000
	508,679	13,415.46	1,106,008	1,738,758	40,710,823	71,131,000
Total, 1926	495,507	16,438.30	1,232,010	1,730,271	38,940,448	62,551,000

ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Chaffee	81	------	------	------	------	47,000
Lake	311	------	------	------	------	95,000
	392	------	------	------	------	142,000
Total, 1926	8,284	2.67	230	------	------	2,419,000

METAL CONTENT OF ZINC-BEARING MATERIALS

The following table gives the kind and grade of zinc-bearing materials marketed in 1927:

Zinc and zinc-lead ore and concentrates as marketed from Colorado mines and mills in 1927, in terms of original content

Classification	County	Dry weight	Gold		Silver	
			Content	Average assay	Content	Average assay
		Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Oxidized: Zinc carbonate smelting ore.	Chaffee and Lake	392				
Sulphide:						
Zinc and zinc-lead concentrates.	Dolores and San Juan	38,092	2,175.66	0.057	214,054	5.62
Crude milling ore and middlings.	Hinsdale, Ouray, San Juan, and San Miguel.	10,943	4,458.37	.407	168,827	15.43
Crude milling and smelting ore.	Gunnison, Lake, and Pitkin.	22,438	35.27	.002	99,057	4.41
Zinc concentrates	Eagle, Lake, and Summit	34,721	(1)	(1)	(2)	(2)
Total sulphide		106,194				
Total oxidized and sulphide.		106,586				

Classification	Copper		Lead		Zinc	
	Content	Wet assay	Content	Wet assay	Content	Assay
	Pounds	*Per cent*	*Pounds*	*Per cent*	*Pounds*	*Per cent*
Oxidized: Zinc carbonate smelting ore					176,868	22.56
Sulphide:						
Zinc and zinc-lead concentrates	836,992	1.10	3,901,169	5.12	39,049,998	51.26
Crude milling ore and middlings	623,007	2.85	4,022,797	18.38	4,529,163	20.69
Crude milling and smelting ore			5,199,984	11.59	12,088,510	26.94
Zinc concentrates			1,549,462	2.23	33,051,217	47.60
Total sulphide	1,459,999		14,673,412	6.91	88,718,888	41.77
Total oxidized and sulphide	1,459,999		14,673,412		88,895,756	

[1] Too small to indicate.

[2] Average about 2 ounces to the ton.

METALLURGIC INDUSTRY

Custom reduction plants.—Custom reduction plants in the State in 1927 comprised the following: Lead bullion-leady copper matte smelters at Leadville and Durango; the magnetic separation mill and zinc oxide plant at Canon City; the zinc oxide plant at Leadville; the fuming, matting, and zinc oxide plant at Florence; the roast-amalgamation-cyanidation mill at Colorado Springs; the Portland-Independence gravity concentration-flotation-cyanidation mill at Victor; the Rawley selective flotation mill at Bonanza; the sampling works at Victor, Idaho Springs, and Boulder; the arsenic-cadmium plant at the old Globe smelter, near Denver; the International selective flotation mill at Rico; and the Colorado Zinc-Lead mill at Leadville.

Mines in Colorado in 1927 produced 1,606,528 tons of ore, of which 105,397 tons, or 6.6 per cent, was shipped crude to smelters; 774,162 tons, or 48.2 per cent, went to amalgamation and cyanidation mills with or without supplementary concentration; and 726,969 tons, or 45.2 per cent, to mills equipped for concentration only. Of the 774,162 tons to amalgamation and cyanidation mills, 287,654 tons was treated by amalgamation followed by concentration. The total ore concentrated, therefore, was 1,014,623 tons, or 63.2 per cent of the State total.

The 105,397 tons of crude ore shipped to smelters was classified as follows: Dry gold ore, 2,710 tons, or 2.6 per cent; dry gold and silver ore, 2,146 tons, or 2 per cent; dry silver ore, 53,281 tons, or 50.6 per cent; copper ore, 467 tons, or 0.4 per cent; copper-lead ore, 410 tons, or 0.4 per cent; lead ore, 24,891 tons, or 23.6 per cent; lead-zinc ore, 21,100 tons, or 20 per cent; and zinc ore, 392 tons, or 0.4 per cent.

The 774,162 tons of ore treated at amalgamation and cyanidation mills was classified as follows: Dry gold ore, 505,673 tons, or 65.3 per cent; dry gold and silver ore, 267,283 tons, or 34.5 per cent; and dry silver ore, 1,206 tons, or 0.2 per cent. Of the total material treated by amalgamation and cyanidation, 574,472 tons was ore amalgamated; 199,690 tons was ore directly cyanided; and 301,321 tons was sands and slimes (from ore and from Teller County concentrates first treated by amalgamation) cyanided. Thirteen amalgamation mills, 1 cyanidation mill, and 1 combined amalgamation and cyanidation mill treated this ore and recovered from it 191,317.26 ounces of gold and 123,241 ounces of silver. Three mills (one amalgamation mill in San Miguel County and one cyanidation mill and one combined amalgamation-cyanidation mill in Teller County) accounted for 98.5 per cent of the gold and 98.2 per cent of the silver in bullion and precipitates produced.

The 1,014,623 tons of ore (including the 287,654 tons first treated by amalgamation) treated by concentration was classified as follows: Dry gold ore, 46,781 tons, or 4.6 per cent; dry gold and silver ore, 276,536 tons, or 27.3 per cent; dry silver ore, 167,343 tons, or 16.5 per cent; lead ore, 36,384 tons, or 3.6 per cent; and lead-zinc ore, 487,579 tons, or 48 per cent. Of the total ore concentrated, flotation plants treated 909,490 tons, or 89.6 per cent, classified as follows: Dry gold ore, 43,088 tons, or 4.73 per cent; dry gold and silver ore, 273,964 tons, or 30.12 per cent; dry silver ore, 165,653 tons, or 18.21 per cent; lead ore, 24 tons, or 0.02 per cent; and lead-zinc ore, 426,761 tons, or 46.92 per cent.

Flotation plants produced 144,109 tons of concentrates, classified as follows: Dry gold concentrates, 230 tons, or 0.2 per cent; copper concentrates, 628 tons, or 0.4 per cent; lead-copper concentrates, 22,742 tons, or 15.8 per cent; lead concentrates, 53,088 tons, or 36.8 per cent; lead-zinc concentrates, 32,637 tons, or 22.6 per cent; and zinc concentrates, 34,784 tons, or 24.2 per cent. The following tables give the classification of flotation concentrates and of concentrates from all concentrating plants, with the gross metal content:

Classification of concentrates produced at all concentrating plants in Colorado in 1927, with gross metal content

Class of concentrate	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	656	1, 176. 11	4, 343	11, 208	19, 806	18, 333
Dry gold and silver	357	216. 34	4, 969	1, 623	16, 381	38, 917
Copper	659	171. 25	45, 280	38, 542	5, 652	3, 710
Lead-copper	23, 597	1, 704. 93	980, 807	4, 981, 785	7, 401, 292	2, 494, 243
Lead	64, 398	39, 722. 66	1, 512, 436	1, 462, 597	45, 221, 741	8, 345, 751
Lead-zinc	34, 083	6, 137. 50	331, 867	1, 102, 783	6, 464, 383	30, 153, 118
Zinc	48, 819	184. 47	40, 509	232, 310	2, 512, 958	47, 006, 450
	172, 569	49, 313. 26	2, 920, 211	7, 830, 848	61, 645, 213	88, 060, 522

Classification of concentrates produced at flotation plants in Colorado in 1927, with gross metal content

Class of concentrate	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	230	366.06	691	2,719	1,109	740
Copper	628	141.05	44,116	35,878	----------	----------
Lead-copper	22,742	965.28	842,759	4,846,733	6,683,128	2,488,250
Lead	53,088	30,359.91	1,423,156	1,673,473	39,262,079	7,628,609
Lead-zinc	32,637	5,489.70	288,609	985,046	5,066,147	29,706,576
Zinc	34,784	186.17	79,857	232,310	2,137,952	36,539,937
	144,109	37,508.17	2,679,188	7,776,159	53,150,415	76,364,112

The flotation concentrates contained 14.7 per cent of total gold produced in Colorado, 70.8 per cent of the silver, 93.6 per cent of the copper, 68.3 per cent of the lead, and 78.9 per cent of the zinc.

Forty-five concentrating plants in Colorado were active in 1927. Eight of these plants employed jigs or tables, 17 were combined table and flotation, and 20 were all-flotation with or without tables for control. Two of the table mills were equipped with magnetic separation machines.

Three flotation plants (including both bulk and preferential)—one in Saguache County, one in San Juan County, and one in San Miguel County—treated 645,518 tons of ore (71 per cent of the total treated by flotation), which yielded 86,173 tons of concentrates (60 per cent of the total from flotation), containing 83 per cent of the gold, 72 per cent of the silver, 91 per cent of the copper, 57 per cent of the lead, and 43 per cent of the zinc. [All percentages are based on gross content.]

Four preferential flotation plants—the Rico International, Colorado Zinc-Lead, Sunnyside, and Wellington—milled 419,729 tons of ore (46.1 per cent of the total treated by flotation), which yielded 97,225 tons of lead and zinc concentrates (67.5 per cent of the total from flotation), containing 34.6 per cent of the gold, 40.1 per cent of the silver, 33.6 per cent of the copper, 70.8 per cent of the lead, and 92.5 per cent of the zinc recovered by all flotation plants. [All percentages are based on gross metal content.]

Mine production of metals in Colorado in 1927, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	574,472	68,005.19	20,326	----------	----------	----------
Ore, sands, and slimes cyanided	501,011	123,312.07	102,915	----------	----------	----------
Concentrates smelted	172,569	49,313.26	2,920,211	5,317,814	53,410,373	62,443,000
Ore smelted	105,397	10,178.56	740,017	352,767	13,362,184	9,286,000
Placer	----------	4,568.25	1,136	----------	----------	----------
	----------	255,377.33	3,784,605	5,670,581	66,772,557	71,729,000

Ores, sands, and slimes treated by amalgamation and cyanidation and gold and silver contained in bullion and precipitates in Colorado in 1927

Process	Material treated	Gold in bullion	Silver in bullion	Quick-silver used	Sodium cyanide used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amalgamation	574, 472	68, 005. 19	20, 326	3, 040	----------
Cyanidation	[1] 501, 011	123, 312. 07	102, 915	----------	[2] 270, 000
	----------	191, 317. 26	123, 241	3, 040	[2] 270, 000

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[1] Includes 199,690 tons of crude ore treated directly by cyanidation and duplicates 301,321 tons (in the form of sands and slimes) from ore and concentrates (Teller County) treated first by amalgamation.

[2] Reduced to equivalent of 96 to 98 per cent strength.

Mine production of metals from gold and silver mills in Colorado in 1927, by counties

County	Ore treated	Recovered in bullion		Concentrates and recovered metal					
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	1, 729	1, 024. 81	163	43	109. 39	4, 955	--------	13, 074	--------
Clear Creek	2, 787	1, 516. 48	626	120	123. 04	640	1, 264	9, 493	--------
Gilpin	2, 675	712. 86	554	227	173. 86	526	435	27, 180	--------
Gunnison	182	92. 88	134	--------	--------	--------	--------	--------	--------
Lake	7, 131	5, 443. 18	10, 168	--------	--------	--------	--------	--------	--------
La Plata	416	944. 41	6, 424	--------	--------	--------	--------	--------	--------
Mineral	1, 206	--------	65, 017	--------	--------	--------	--------	--------	--------
Ouray	3, 028	409. 67	151	153	647. 49	3, 265	5, 384	12, 302	--------
Park	55	126. 05	30	--------	--------	--------	--------	--------	--------
Rio Grande	137	6, 459. 51	268	--------	--------	--------	--------	--------	--------
San Miguel	265, 666	14, 574. 18	13, 389	25, 428	28, 390. 50	623, 600	54, 118	6, 143, 430	456, 000
Summit	200	12. 71	973	14	68. 00	560	--------	1, 852	--------
Teller	488, 950	160, 000. 52	25, 344	(1)	(1)	(1)	--------	--------	--------
	774, 162	191, 317. 26	123, 241	25, 985	29, 512. 28	633, 546	61, 201	6, 207, 331	456, 000
Total, 1926	958, 924	246, 626. 93	41, 333	36, 446	48, 229. 75	886, 617	101, 100	7, 255, 850	--------

[1] Concentrates produced were cyanided and contents are included in bullion recovered.

Mine production of metals from concentrating mills in Colorado in 1927, by counties

County	Ore treated	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	20, 000	697	2, 902. 71	34, 964	1, 153	132, 413	----------
Clear Creek	5, 302	616	852. 05	15, 605	6, 397	125, 716	----------
Custer and Dolores	95, 002	21, 737	352. 91	157, 357	122, 000	9, 886, 000	10, 615, 000
Eagle and Summit	86, 681	22, 225	434. 87	63, 630	4, 137	5, 181, 567	13, 008, 000
Gilpin	902	178	166. 41	2, 512	3, 087	14, 195	----------
Gunnison	1, 289	921	8. 99	11, 381	2, 448	407, 530	455, 000
Hinsdale	110	70	12. 12	500	1, 793	29, 648	44, 000
Lake	66, 224	25, 472	449. 91	160, 074	14, 000	5, 069, 762	14, 651, 000
Ouray	8, 954	861	173. 01	45, 850	38, 605	119, 794	93, 000
Park	1, 500	72	337. 60	407	137	9, 585	----------
Saguache	112, 393	22, 742	965. 28	842, 759	3, 378, 000	6, 000, 000	----------
San Juan	282, 534	47, 080	12, 152. 60	709, 836	1, 533, 805	17, 150, 527	22, 869, 000
San Miguel	46, 078	3, 913	992. 52	241, 760	151, 051	3, 076, 305	252, 000
Summit	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	726, 969	146, 584	19, 800. 98	2, 286, 665	5, 256, 613	47, 203, 042	61, 987, 000
Total, 1926	666, 382	120, 497	21, 909. 77	2, 049, 661	2, 748, 271	41, 037, 650	49, 922, 300

[1] Included with Eagle County.

Mine production of metals from Colorado concentrates in 1927

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	740	3, 012. 10	39, 919	1, 153	145, 487	------------
Clear Creek	736	975. 09	16, 245	7, 661	135, 209	------------
Custer and Dolores	21, 737	352. 91	157, 357	122, 000	9, 886, 000	10, 615, 000
Eagle and Summit	22, 239	502. 87	64, 190	4, 137	5, 183, 419	13, 008, 000
Gilpin	405	340. 27	3, 068	3, 522	41, 375	------------
Gunnison	921	8. 99	11, 381	2, 448	407, 530	455, 000
Hinsdale	70	12. 12	500	1, 793	29, 648	44, 000
Lake	25, 472	449. 91	160, 074	14, 000	5, 069, 762	14, 651, 000
Ouray	1, 014	820. 50	49, 115	43, 989	132, 096	93, 000
Park	72	337. 60	407	137	9, 585	------------
Saguache	22, 742	965. 28	842, 759	3, 378, 000	6, 000, 000	------------
San Juan	47, 080	12, 152. 60	709, 836	1, 533, 805	17, 150, 527	22, 869, 000
San Miguel	29, 341	29, 383. 02	865, 360	205, 169	9, 219, 735	708, 000
Summit	(1)	(1)	(1)	(1)	(1)	(1)
	172, 569	49, 313. 26	2, 920, 211	5, 317, 814	53, 410, 373	62, 443, 000
Total, 1926	156, 943	70, 139. 52	2, 936, 278	2, 849, 371	48, 293, 500	49, 922, 300

BY KINDS OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	656	1, 176. 11	4, 343	6, 624	15, 502	------------
Dry gold and silver	357	216. 34	4, 969	1, 137	15, 050	18, 000
Copper	659	171. 25	45, 280	36, 046	4, 945	------------
Copper-lead	23, 597	1, 704. 93	980, 807	3, 475, 800	6, 663, 648	------------
Lead	64, 398	39, 722. 66	1, 512, 436	1, 024, 259	40, 197, 812	438, 000
Total to copper and lead plants	89, 667	42, 991. 29	2, 547, 835	4, 543, 866	46, 896, 957	[2] 456, 000
Lead-zinc	34, 083	6, 137. 50	331, 867	771, 948	5, 743, 299	22, 869, 000
Zinc	48, 819	184. 47	40, 509	2, 000	770, 117	39, 118, 000
Total to zinc and lead-zinc plants	82, 902	[3] 6, 321. 97	[3] 372, 376	[3] 773, 948	[4] 6, 513, 416	[5] 61, 987, 000
	172, 569	49, 313. 26	2, 920, 211	5, 317, 814	53, 410, 373	62, 443, 000

[1] Included with Eagle County.
[2] Recovered at sulphating plant, Durango, Colo.
[3] Recovered in zinc residues.
[4] Lead recovered in zinc residues and leaded zinc oxide.
[5] Zinc recovered as metal and zinc in zinc oxide.

Mine production of metals from Colorado crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	138	228. 95	1, 516	2, 283	21, 801	------------
Chaffee	318	13. 11	2, 035	------------	68, 700	47, 000
Clear Creek	566	559. 01	19, 808	10, 148	108, 730	------------
Custer	29	. 48	342	99	1, 983	------------
Dolores	1, 801	57. 70	16, 038	9, 000	783, 777	------------
Eagle	5, 007	285. 41	52, 564	89, 000	200	------------
Fremont	26	1. 31	136	801	2, 492	------------
Garfield	66	. 53	194	------------	10, 142	------------
Gilpin	288	277. 34	3, 990	5, 188	51, 260	------------
Gunnison	496	99. 27	8, 224	1, 033	284, 152	------------
Hinsdale	268	22. 47	2, 946	803	125, 637	------------
Lake	67, 720	6, 084. 90	241, 229	158, 450	8, 493, 000	9, 039, 000
La Plata	197	173. 20	2, 488	------------	------------	------------
Mesa	1	------------	81	893	------------	------------
Mineral	2, 386	11. 90	149, 833	------------	75, 286	------------
Ouray	700	81. 09	30, 025	41, 721	158, 617	------------
Park	373	1, 443. 29	3, 471	3, 161	29, 892	------------
Pitkin	23, 525	------------	152, 328	------------	2, 406, 888	200, 000
Saguache	122	2. 80	2, 285	504	30, 222	------------
San Juan	290	82. 75	16, 455	15, 409	120, 489	------------
San Miguel	746	683. 54	27, 200	14, 274	427, 805	------------
Summit	334	69. 51	6, 829	------------	161, 111	------------
	105, 397	10, 178. 56	740, 017	352, 767	13, 362, 184	9, 286, 000
Total, 1926	214, 434	23, 361. 99	1, 725, 942	554, 479	20, 694, 300	15, 077, 700

Mine production of metals from Colorado crude ore shipped to smelters in 1927—Con.

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	2,710	5,109.90	19,781	26,302	164,143	-----------
Dry gold and silver	2,146	1,881.63	42,728	67,823	77,787	-----------
Dry silver	53,281	474.21	404,887	120,361	3,390,003	-----------
Copper	467	140.61	14,888	54,313	10,048	-----------
Copper-lead	410	87.61	8,284	43,466	134,940	-----------
Lead	24,891	2,484.60	244,070	40,502	6,268,375	-----------
Total to copper and lead plants	83,905	10,178.56	734,638	352,767	10,045,296	-----------
Lead-zinc	21,100	-----------	5,379	-----------	3,316,888	9,144,000
Zinc	392	-----------	-----------	-----------	-----------	142,000
Total to zinc smelters and zinc-oxide plants	21,492	-----------	[1] 5,379	-----------	[2] 3,316,888	[3] 9,286,000
	105,397	10,178.56	740,017	352,767	13,362,184	9,286,000

[1] Recovered in zinc residues.

[2] Lead recovered in zinc residues and leaded zinc oxide.

[3] Zinc recovered as zinc in zinc oxide.

REVIEW BY COUNTIES AND DISTRICTS

ADAMS COUNTY

Gold-saving devices attached by individual lessees to the tailrace of several gravel screening and washing plants in the bed of Clear Creek above and below the extension of Federal Boulevard in Adams County, north of Denver city limits, recovered $3,340 in placer gold and 23 ounces of silver. The gravels constitute both stream and low-lying bench formations in the flood plain of the creek.

BOULDER COUNTY

Central district (Jamestown).—Seven mines near Jamestown in 1927 produced 312 tons of ore, yielding $8,643 in gold, 314 ounces of silver, 1,252 pounds of copper, and 19,588 pounds of lead, with a total gross calculated value of $10,219. The lead and copper came from 49 tons of smelting ore from the Argo and Buckhorn properties; this ore carried also 11.12 ounces of gold and 312 ounces of silver. The Buckhorn, a former productive mine, was reopened in 1927. The most important shipment in 1927 was gold ore from a lease on the Wano mine. Other small gold producers were the Alice, Little More, New Rival, and Stanley. The Central district is also known for its fluorspar deposits, which occur as the gangue of the gold ores and in a large brecciated zone. Nearly 600 tons of fluorspar was milled in 1927 at the Lehman gravity concentrating mill at Jamestown.

Gold Hill district.— The Gold Hill district in 1927 produced 152 tons of ore, yielding $5,034 in gold, 552 ounces of silver, 1,031 pounds of copper, and 2,048 pounds of lead. All the ore, with the exception of 7 tons of lead-gold-silver smelting ore from the Black Cloud, was dry gold, most of which was sold through the Boulder ore sampling works, where it was mixed for distribution to the Golden Cycle mill, at Colorado Springs, to the Arkansas Valley lead plant, at Leadville, or to the refinery at Omaha. Other producing properties were the Colorado, Glad Eye, Great Gold, Happy Thought, Hill Top, Ingram, Inter Ocean, Phil Sheridan, Poorman, and Richmond.

Grand Island district (*Cardinal, Caribou, Eldora, and Nederland*).—The Grand Island district in 1927 produced 21,002 tons of ore, yielding gold, silver, copper, and lead, with a total gross calculated value of $95,860. The Fairview Mining Co. continued to operate the Boulder County group near Nederland and ran its 100-ton flotation and gravity concentration mill at about three-fourths capacity throughout the year, with occasional shutdowns. This mill is equipped with one 400-ton Universal crusher, one 100-ton Universal crusher, one 110-ton Ruth rod mill, seven old gravity concentration tables of different makes, one Denver Sub-A flotation machine, one Ruth flotation machine, one Brown air flotation machine, cone classifiers, settling tanks, and driers. During 1926 and 1927 an amalgamation-gravity concentration mill was under construction at the Potosi mine at Caribou, and during 1927 test runs were made. The mill is equipped with 1 Gates gyratory crusher, 1 Straub crusher, 60 Straub stamps, 6 Straub Tyler screens, amalgamating plates, 3 Wilfley tables, and 1 Overstrom table.

Magnolia district.—Several small lots of ore, aggregating 35 tons, were mined from four properties in the Magnolia district and sold to the Boulder sampler, which distributed the lots to the Golden Cycle mill or to the Leadville smelter. The estimated recovery from the 35 tons was 82.29 ounces of gold and 53 ounces of silver.

Sugar Loaf district.—Eight mines in the Sugar Loaf district in 1927 produced 366 tons of ore, which yielded 434.07 ounces of gold and 642 ounces of silver. Lessees on the Gladys mine made a new surface discovery of gold ore. The ore was crushed in a small jaw crusher, and was then put through a small ball mill and amalgamator, which treated 3 tons a day for a short time, resulting in several hundred ounces of gold-silver retorts. Lessees working in the Wood Mountain mine produced (without development work) dry gold ore which was sold to the Boulder sampler or amalgamated and retorted at the Wood Mountain mill. On September 15, 1927, the mine and mill were sold to the Mountain Plains Co., who did development work during the remainder of the year at a cost of $11,500. Other small producing properties were the Clipper, Dime, Gray Copper, Little Belle, Logan, and Red Signe.

Ward district.—No work was done in the Ward district in 1927.

CHAFFEE COUNTY

Chalk Creek district (*Romley*).—The Mary Murphy mine and mill remained idle in 1927. Assessment work was done on several prospects in the Chalk Creek district.

Granite district.—A small sluicing operation on the bench gravels of the Arkansas River, near Granite, recovered 5.81 ounces of gold. During the summer and fall of 1927 a suction dredge boat was in course of construction on the west side of the Arkansas River, below Granite. The plan is to float the boat in the river and to draw up the fine river gravel and silt, which will be treated on the boat. The site is just below the bench gravels on Cache Creek, from which $1,500,000 to $3,500,000 in placer gold was recovered by sluicing and hydraulicking from 1859 to 1911, when the work was stopped by court injunction at the request of the cities of Pueblo, Canon City, and Salida.

La Plata district (*Winfield*).—One ton of lead-silver ore from the Banner prospect was packed down to Granite and shipped to Leadville.

Monarch-Garfield district.—Lessees on the Jewell Tunnel group shipped three narrow-gauge cars of lead-silver oxidized ore. Development work on the Madonna mine resulted in the shipment of 28 tons of lead-silver oxidized ore. Lessees on the Paymaster property shipped several cars of zinc oxidized and lead-silver sulphide ore. Before operations ceased on the Marshall Tunnel and the Garfield and Great Monarch claims the Rogers Lead Co. shipped six narrow-gauge cars of lead-silver ore.

CLEAR CREEK COUNTY

Alice district (*Yankee, Lincoln*).—For a short time before dissolving, the Fall River Mining Co. early in 1927 ran the Lombard amalgamation-gravity concentration mill at Alice on low-grade gold-silver-lead-zinc ore from the Lombard property, making lead-[zinc]-gold-silver concentrates. The Caddo Mining & Milling Co. took over the Yukon group and amalgamation-gravity concentration mill, ran the mill for a short time, and marketed the bullion but held the concentrates produced.

Argentine district (*Silver Plume*).—No development work was done at the 1,600-foot adit of the Gold Belt Tunnel group, but during the last few days of 1927 lessees shipped 6 tons of lead-silver [zinc] ore to the Idaho Springs sampler. The Kelso-National Mining Co. in 1927 put up a 150-foot raise under the shaft on the National claim, making the total development 150 feet of adit, 1,500 feet of drifts, and 230 feet of shaft. Several hundred tons of lead ore was mined from the National and was concentrated at the Georgetown Tunnel Transportation Co.'s mill. The lead concentrates were shipped to the Leadville smelter. One narrow-gauge car of lead-gold-silver ore was shipped from the Santiago mine to the Idaho Springs sampler.

Empire district.—A 3-ton lot of gold ore was shipped from the Mint property to the Idaho Springs sampler. The Rose City No. 2 flotation mill (originally built in 1921) was remodeled by the addition of a flotation unit, classifier, and filter. It was operated on pyritic gold ore from the Gold Dirt mine, producing a pyritic concentrate that carried 1.5 ounces of gold to the ton, nearly 1 ounce of silver, and traces of copper. The property is opened by the Empire Tunnel, which had to be cleaned out before milling began. A 90-foot raise was put up, old stopes were drawn, and ore began to move to the mill in June, 1927. A new stope was opened later.

Geneva Creek district (*Grant*).—A small lot of silver-lead-copper ore was shipped to Leadville from the Revenue claim in Virginia Gulch at the head of Geneva Creek.

Griffith district (*Georgetown-Silver Plume*).—Eleven mines in the Georgetown-Silver Plume district produced in 1927 only 450 tons of ore, yielding $159 in gold, 13,097 ounces of silver, and 31,429 pounds of lead, with a total gross calculated value of $9,565 as compared with $176,663 in 1926. The East Butte Copper Co. did no development on its Pelican-Seven-Thirty group nor did it operate its 250-ton flotation mill (53,500 tons of ore was treated in 1926), but lessees shipped a few cars of lead-silver ore from the property. Lessees on the Antelope mine mined a car of lead-zinc-silver ore, which was milled at the Wasatch-Colorado jig and table mill, yielding a few tons of lead-silver concentrate and a few tons of zinc concentrate (not sold). A car of lead ore carrying also zinc, was mined from the Dunkirk-Payrock group and milled at the Rose City No. 2 mill, yielding a lead-silver concentrate. Several hundred tons of lead-zinc-silver ore from the Clara B mine was milled at the Georgetown Tunnel Transportation Co.'s flotation-gravity concentration mill, yielding a lead-zinc concentrate, the zinc of which was lost in smelting. The Wasatch-Colorado jig and table concentrating mill was operated for a short period, but the lead and the zinc concentrates produced were not marketed in 1927, awaiting a higher metal market. Other small producers were the Buster, Capital, Cyclone, Daniel Peters, East Griffith, and Mammoth. At the Mineral Chief property (opened by a 2,000-foot adit) 200 feet of drifting, 250 feet of crosscutting, and 55 feet of winzing were done. The St. George 60-ton flotation mill was idle, but development work was done at the mine.

Idaho Springs district.—Twenty-one mines in the Idaho Springs district produced 4,104 tons of ore, yielding $48,264 in gold, 11,956 ounces of silver, 16,381 pounds of copper, and 68,190 pounds of lead, with a total gross calculated value of $61,485 as compared with $86,897 in 1926. The largest producing property was the West Gold, from which gold telluride and free gold ore were shipped to the Golden Cycle mill at Colorado Springs. The next largest producing property was the Specie Payment, from which gold smelting ore was sold to the Idaho Springs sampler and gold milling ore was treated at the Newton gravity concentration-flotation mill at Idaho Springs. Gold ore from the Treasure Vault mine was sold to the Golden Cycle mill; small test lots went to the Combination mill and to the Elliott-Barber mill, both at Idaho Springs. Some gold ore from the Elliott-Barber mine was sold to the Golden Cycle mill and some was treated at the company's own concentration mill. The North American Mining Co.'s Central (or Big Five) 9,454-foot crosscut adit was placed in operating condition by removing the fallen rock, retimbering where necessary, relaying new rails, and repairing ore cars, power house, and motors so that custom tramming could be done and air furnished for ventilation and for power for drills and hoists at the Lake mine. In addition, lessees operated the North American's own veins—the Edgar, the Bald Eagle, and the Fulton. The lessees' ore consisted of dry gold and silver ore, which was sent to the Newton mill, and of dry gold and silver and lead-silver-gold-copper smelting ore. Lead-copper-silver-gold and dry gold and silver concentrates were produced. No production was made from the Lake mine, but 1,200 feet of drifts, 200 feet of crosscuts, and 190 feet of raises were driven between January 12 and September 30, 1927. Other producers were the Almaden, Lincoln, Little Mattie, Lord Byron, May Day, Maud Monroe, and P. T.

Montana district (*Lawson, Dumont*).—Five mines in the Montana district produced 340 tons of ore, yielding $115 in gold, 5,349 ounces of silver, and 26,698 pounds of lead, with a total gross calculated value of $4,830 as compared with $39,586 in 1926. Producing mines were the Bellevue-Hudson, De Caprivi, Jo Reynolds, Millington, and Senator.

Trail Creek district (*Lamartine, Freeland*).—The Trail Creek district produced 376 tons of ore, yielding $2,395 in gold, 1,125 ounces of silver, 313 pounds of copper, and 52,238 pounds of lead, with a total gross calculated value of $6,365 as compared with $14,253 in 1926. Lead-gold-silver smelting ore was shipped from the Brighton, Crazy Girl, Neglected, and New Era; gold ore was shipped from the Donaldson-Wheatland and Puckett to the Golden Cycle mill. At the New Era mine retimbering, cleaning out cave-ins, and relaying track and air lines was begun in February, 1927. The mill was repaired and was operated during June and to July 15 on a test run. The ore is crushed to ¼ inch; it then goes to rolls and to jigs; tailings from jigs go to regrind and to tables. The concentrates produced were lead-gold-silver. Development work at the New Era totaled 225 feet of drifts; at the Crazy Girl, 200 feet of shaft sinking and 3,000 feet of drifts; and at the Neglected, 100 feet of drifts. The Freeland mine and mill were idle.

CONEJOS COUNTY

Platoro district (*Ute, Decatur*).—Assessment work was continued in the Platoro district, a producer from 1882 to 1906.

CUSTER COUNTY

Hardscrabble district (*Westcliffe, Silver Cliff*).—Several small lots of highly siliceous silver ore were shipped in 1927 from Westcliffe, from the Black Friday, Maxine Elliott, and S. A. K. groups. The new shaft on the Passiflora mine was continued to 280 feet and drifts run, but no ore was shipped.

Oak Creek district (*Ilse*).—At the Terrible mine at Ilse, 23 miles from Florence, development work amounted to 2,587 feet in 1927. The ore, a low-grade lead ore containing cerussite without gold, silver, or other metals, was concentrated as theretofore by Wilfley tables and Harz jigs. The high-grade lead concentrate produced was as usual sent to the Eagle-Picher Lead Co., at Joplin, Mo.

DOLORES COUNTY

The total gross calculated value of the mine production of metals in Dolores County in 1927 (all from Rico) was $1,432,554 as compared with $990,281 in 1926, $353,563 in 1925, and $24,220 in 1924.

With the exception of lead-silver smelting ore from the Pigeon, Shamrock, and Union Carbonate mines, all the ore mined was complex lead-zinc-copper-silver-gold-iron sulphide milling ore, which was treated at the International custom selective flotation plant at Rico. This 225-ton plant began operations October 1, 1926, and operated for nine months in 1927.

The milling ore came from various properties under various ownerships and various options and leases. The largest production was from the Rico-Argentine, followed by the Falcon Lead Mining Co., the combined output of the Rico Mining & Reduction Co. and its successor, the St. Louis Smelting & Refining Co., the Pelleyre Mining & Milling Co. (subsidiary of the International Smelting Co.), and the Rico Enterprise Mining Co.

The Rico Argentine Mining Co. mined its ore from the Black Hawk group, through the Log Cabin, Argentine, and Blaine adits. This company declared a dividend of $24,000, or $0.03 per share, on January 1, 1928. The property was in litigation for six years prior to 1925, but a settlement was reached in December, 1924, and mining operations began in January, 1925. Shipments of lead-zinc ore to Utah began in August, 1925. The Falcon Lead Mining Co. mined its ore from the Nigger Baby Hill (or Yellow Jacket) group, upon which 878 feet of raises, 1,788 feet of drifts, and 1,287 feet of crosscuts were driven in 1927. The Rico Mining & Reduction Co. operated the Lillie D., Silver Swan, Maggie group, Iron group, and Argentine group until May 1, 1927, when all its holdings, assets, and liabilities were transferred to the St. Louis Smelting & Refining Co. The Pelleyre Mining & Milling Co. mined its ore from the Shamrock claim. The Rico Enterprise Mining Co. mined its ore from the Pro Patria claim, upon which 190 feet of raises, 319 feet of drifts, and 425 feet of crosscuts were driven in 1927. The former Rico Wellington Mining Co. was operated by the Rico Mining & Reduction Co. and later by the St. Louis Smelting & Refining Co. The Union Carbonate mine is opened by various adits; the old vertical shaft has caved; about 1,600 feet of drifts, raises, inclines, and crosscuts were driven in 1927; the ore is oxidized, and the minerals are cerussite, anglesite, galena, limonite, and a little minium, plumbojarosite, and smithsonite; sorting by hand and close selective mining were used. At the Badger group drifting and crosscutting amounting to about 150 feet were done under lease and option until the termination of such on March 31, 1927; the group is opened by the 700-foot Badger adit and by the 510-foot Hidden Treasure adit to the old Sunflower shaft, from which several hundred feet of drifting had previously been done. No ore was produced from the A. B. G. and C. V. G. groups, upon which the Rico Ventura Mining Co. drove 325 feet of drifts, 40 feet of raises, and a 100-foot shaft. The Buckhorn group is opened by an adit 1,500 feet long with several hundred feet of laterals; parts of the tunnel were retimbered and 200 feet of new drifting was done; this property was once opened by the Sawyer shaft, said to be 236 feet deep, now caved and inaccessible.

The International Smelting Co.'s Rico mill, installed in 1926 in the old Pro Patria mill building (with additions), began operations in October, 1926. Ore is brought to the mill by team and truck. Crushing is done by an 18 by 24 inch Blake crusher, by 42 by 16 inch Traylor rolls, and by an 8-foot by 36-inch ball mill. Other equipment includes one 10-foot Dorr drag classifier, two Minerals Separation (14 cells each) flotation machines, one American 6-leaf filter, and two 25 by 9 by 11 redwood thickening tanks. The mill was idle in June, July, and August, owing to low market prices for lead and zinc and pending the making of new contracts.

Dunton district.—At the Emma mine at Dunton retimbering was done and flotation cells were added to the 15-stamp mill, but no ore was treated in 1927. At the Smuggler-Almont mine 232 feet of drifts and 55 feet of crosscuts were driven; the 20-stamp concentrating mill on this property has been idle for 15 years.

DOUGLAS COUNTY

Newlin Gulch district (Parker).—Pipes were laid for pumping water from the stream bed of Newlin Gulch to the west bench of the gulch; there pits and trenches were dug in the nearly flat-lying Dawson arkose beds where the Castle Rock conglomerate has been eroded. A little gold was recovered from pannings and small sluicing operations, but none was marketed in 1927. Part of this area is under the control of the State Land Board, which has insisted on the sinking of shafts. This gulch and adjoining gulches leading into Cherry Creek and South Platte River furnished enough gold in 1842 and thereafter to lead the Russell party of 1858, in search of gold, from Georgia to the present site of Denver. Although the results obtained from this reconcentrated arkose were disappointing, they lured the prospectors to the region, whence they followed up the more recent (geologically) stream bed of Clear Creek and in 1859 found rich residual gold surface deposits at Blackhawk and stream and bench gravels at Idaho Springs. Henderson[2] wrote a history of the discovery and of the development of mining in Colorado from 1859 to 1923.

EAGLE COUNTY

Battle Mountain district (*Red Cliff, Gilman*).—The Empire Zinc Co. continued development work on its large area of mining property on Battle Mountain. The property is opened by an adit at Belden on the Denver & Rio Grande Western Railroad, in Eagle River Canyon, and by a vertical shaft at Belden. The Iron Mask and Black Iron groups are the chief and best-known claims included in the property. Lead-silver oxidized ore was first discovered here in 1879 in the limestone beds, and shortly thereafter gold ores were discovered in the underlying quartzite. Much manganiferous iron ore was shipped in the early days of the district. When sulphides were reached the zinc in the ore proved troublesome; in 1905, however, they were handled successfully by magnetic separation. From 1914 to 1918 much zinc-lead sulphide ore was shipped direct to zinc retort and zinc-lead pigment plants. The Empire Zinc Co. acquired part of its property between 1912 and 1914 and has since added to it. It has shipped yearly zinc-lead sulphide ore in considerable quantity (none in 1921) to its magnetic mill at Canon City and iron-silver sulphide ores to smelters in Colorado and Utah. Since October, 1927, no zinc-lead-iron sulphide ore has been shipped to Canon City because of a decision to close down the Canon City magnetic plant (operated continuously since 1902 except from November, 1920, to November, 1922) and to build a flotation mill at Belden. Iron-silver sulphide ores, however, were shipped throughout 1927. Other producing mines in the Battle Mountain district in 1927 were the Ground Hog, Horn Silver, Ovee, and Tram.

Brush Creek district (*Eagle*).—Assessment work was done at the Lady Belle-North Dakota group. During the period 1913 to 1918 this group produced 200,000 ounces of silver from surface and shallow inclined workings in sandstone.

Fulford district.—Assessment work was done at the Polar Star group.

Holy Cross district.—Assessment work was done on several claims on the flanks of Holy Cross Mountain.

Lake Creek district (*Edwards*).—Persistent reports since 1924 of placer gold deposits on Lake Creek resulted in the examination of the gravels by several engineers in 1927 and in the sinking of several test pits.

McCoy district.—Attempts were again made to recover placer gold from stream gravels of Colorado River near McCoy.

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[2] Henderson, Chas. W., Mining in Colorado: U. S. Geol. Survey Prof. Paper 138, 1926, 263 pp.

ELBERT COUNTY

No gold was recovered in 1927 from the Dawson arkose beds, from which a small quantity of gold with a fineness of 0.992½ was recovered in 1926 near Elizabeth. These arkose beds are the continuation of those mentioned under Douglas County.

EL PASO COUNTY

The Golden Cycle 1,200-ton roast-amalgamation-cyanidation mill at Colorado Springs was operated continuously on gold telluride ores from the Cripple Creek district and small lots of telluride ore from Boulder County and Clear Creek County mines. The Cresson and United Gold Mines group in the Cripple Creek district continued to supply the bulk of the better grade of ore, but the mill continued to accept an unusually large quantity of low-grade dump material from Cripple Creek. Crushers, a ball mill, and a Dorr classifier were installed to prepare for treatment by cyanidation, without roasting and amalgamating, gold pyrite ores from Leadville, Empire, Idaho Springs, Russell Gulch, and Rollinsville, siliceous silver ores from Creede, high-grade specimen gold ore from Summitville, siliceous gold and silver ores from La Plata, and siliceous gold ores from Alma. The Golden Cycle mill is operated by electricity developed at the mill by steam turbine. Coal for roasting the ore and for firing the boilers comes from the Pikes Peak mine just north of Colorado Springs. For description of this mill, see Teller County (p. 564).

FREMONT COUNTY

Canon City-Florence mills and smelters.—The Empire Zinc Co.'s magnetic separation plant was operated steadily, treating lead-zinc-iron sulphide ores from its Eagle County mines, but during November and December this mill was merely cleaning up the stock on hand, as no shipments were made from the Eagle County mines after October. The mill will be dismantled. The Empire Zinc Co.'s zinc oxide plant at Canon City was operated continuously on zinc sulphide concentrates from the company's mill at Hanover, N. Mex., and a small tonnage of custom zinc carbonate ore from Leadville. The River Smelting & Refining Co.'s matting, fuming, and zinc oxide plant at Florence purchased no ore in 1927 but ran a short time to clean up stock of lead-zinc ore and concentrates on hand.

Cotopaxi district.—Two cars of low-grade silver sulphide ore carrying also a little copper and lead were shipped from the Cotopaxi mine, 1 mile north of Cotopaxi.

GARFIELD COUNTY

Newcastle district.—Development work was done at the Gray Eagle property, near Newcastle.

Rifle Creek district (*Rifle*).—Several cars of silver-lead-zinc-gold oxidized ores were shipped in 1927 from a prospect called the Grand View near Vanadium Ranch, 15 miles from Rifle. Near by is the vanadium mine of the United States Vanadium Corporation. This company has a 110 to 140 ton reduction plant at Rifle on the Denver & Rio Grande Western Railroad and operated steadily during the year. The ore is hauled from the mine to the mill by gasoline-propelled trucks.

GILPIN COUNTY

In 1926 Gilpin County produced gold, silver, copper, lead, and zinc, having a total gross calculated value of $89,547, but in 1927 no zinc was recovered, and the value of the four other metals totaled only $39,696. Of the 3,865 tons of ore produced in 1927, 195 tons was lead-silver-gold ore; the rest was gold, silver, and gold and silver ore. Placers yielded 43.29 ounces of gold and 9 ounces of silver in 1927.

Southern districts (*Black Hawk, Central City, Nevadaville, Russell Gulch*).—The lode mines of the combined southern districts of Gilpin County in 1927 produced 3,257 tons of ore, yielding $24,680 in gold, 7,605 ounces of silver, 8,710 pounds of copper, and 92,635 pounds of lead, with a total gross calculated value of $35,969. The Eureka, at Central City, was the most important producing mine and was followed by the Incidental, Pewabic, and Arizona-Morning Star, all in Russell Gulch, and the Concrete and Burroughs group, in the Eureka district. The Eureka 20-stamp amalgamation-gravity concentration mill, operated by lessees, was closed in October. The ore from the Incidental up to the time of closing in March went either to the Golden Cycle mill at Colorado Springs or to the Mid-west mill at Black Hawk. The Pewabic ore went either to the Golden Cycle mill or to the "Dump Mine" amalgamation mill. The Arizona-Morning Star ore was in part smelted and in part treated at the Newton mill, Idaho Springs.

The Rose City No. 1 custom selective flotation mill (formerly the Iron City) was idle till November, 1927, when it burned down. The most important development work done in the county was that done on the Concrete and Kansas-Phoenix-Ophir-Burroughs groups by the Quartz Hill Holding Co. At the Concrete 395 feet of drifting and 413 feet of upraising were done to connect with the shaft so as to drain the upper workings and to give ventilation. Other producing mines were the Aetna Tunnel group, Atlantic, Bonanza Tunnel group, Dumas, Ivanhoe, Jennie Blanche, La Framas, Marquette, Pennsylvania, Saunders, and Snowden.

Northern districts.--The northern districts marketed 608 tons of ore, yielding $2,823 in gold and 7 ounces of silver. The Perigo amalgamation-gravity concentration mill near Rollinsville was operated part of the year and yielded amalgam gold and dry gold concentrates. At the Smuggler mine near Rollinsville the New Life Mining & Milling Co. added four new claim locations, with necessary assessment work and surveys, built new cabins, remodeled the 10-stamp amalgamation-gravity concentration mill, drove 274 feet of main adit (making it 2,130 feet in length), raised 182 feet for air, opened two stopes, and ran the mill from November 9 to December 31, but did not market the concentrates in 1927. This property has other openings, consisting of 1,400 feet of incline shaft and winzes and 3,800 feet of drifts. A lessee marketed a few ounces of amalgam gold bullion recovered from the treatment of ore from the Newport-Providence group.

The Evergreen Mining Co. at Apex ran its 125-ton concentrating mill from April to August, yielding copper concentrates, which were held for treatment in the company's electric furnace under construction and experimentation. This property is developed by an 822-foot vertical shaft and 6,000 feet of drifts. The J. J.

Mining & Milling Co. at Apex drove 125 feet on its adit, making it 1,200 feet in length.

GRAND COUNTY

No production of metals was made in Grand County in 1927.

Elk Mountain district (*Hot Sulphur Springs*).—On the Elk Mountain claims, 4 miles northwest of Hot Sulphur Springs, 100 feet of adit was driven in 1927. A total of over 3,000 feet of adit openings has been driven on these claims.

La Plata (*Jones Pass*) *district* (*Empire*).—No work was done at the Ready Cash-Helping Hand group from which in recent years small lots of high-grade silver ore have been marketed.

St. Louis Lake district.—Assessment work was done in 1927 on the Mt. Vasquez Mines Co.'s property near St. Louis Lake at the head of St. Louis Creek.

GUNNISON COUNTY

Domingo district (*Goose Creek*).—The only development in the Domingo (Goose Creek, Spencer) district in 1927 was assessment work on the Good Friday claim and on the Anaconda property.

Elk Mountains district (*Crested Butte*).—Development work was done in 1927 on the Hill Top-Blue Streak-Flapper group, 10 miles north of Crested Butte.

Galena Mountain district.—In 1927 the Puritan Mining Co. patented 640 acres of mineral claims on Galena Mountain near Schofield Pass.

Gold Brick district (*Ohio*)—The Carter Mines Co., operating its mine and 20-stamp amalgamation-concentration mill for a short time, shipped gold-silver amalgam bullion to the Denver Mint and one car of siliceous gold ore to the Leadville smelter. A clean-up of the Raymond mill resulted in the production of gold-silver amalgam and a small lot of lead-gold-silver smelting ore. A small lot of gold ore was shipped from the Victory claim to the Leadville smelter. Development work was done on the Dodson and Velvet claims and on the Treasury Tunnel group.

Quartz Creek district (*Pitkin*).—A small lot of lead-silver ore was shipped the last of December from the Mountain Boy claim on Fairview Peak to the Leadville smelter. The Roosevelt adit was driven 700 feet, making it 5,000 feet in length.

Rock Creek district (*Marble*).—No development work was done in the Rock Creek district in 1927.

Spring Gulch district.—The Doctor mine in Spring Gulch was idle in 1927.

Taylor Park district.—Several cars of lead-silver oxidized ore were shipped from the Independent-Star group on Italian Mountain to the Leadville smelter. This group is opened by two vertical shafts, each 300 feet deep. Fifty feet of drifts were run in 1927.

Tin Cup district.—Cleaning out the Gold Cup adit and development work were in progress during the summer of 1927.

Tomichi district (*Whitepine*).—From the Akron group several hundred tons of lead-zinc-silver sulphide ore was shipped in 1927 to the International selective flotation mill at Tooele, Utah, and several cars of lead-silver smelting ore were shipped to Tooele and Midvale, Utah. From the Morning Star group several hundred tons of lead-zinc-silver sulphide ore was shipped to the Midvale, Utah, selective flotation mill.

HINSDALE COUNTY

The total gross calculated value of the mine production of gold, silver, copper, lead, and zinc (in terms of recovered metals) in Hinsdale County in 1927 was $15,608, as compared with $17,915 in 1926. Of the 378 tons of ore marketed in 1927, 268 tons was lead-silver-gold-copper and 110 tons lead-zinc-copper-silver-gold. Producing mines were the Big Casino, Black Crook, California, Capitol City Dump, Czar, Vermont, and Ute-Ulay. The Empire Chief Mining Co., which in 1925 consolidated the Highland Chief and Lead Mines group, employed 8 men in development work throughout 1927 and completed 1,000 feet of adit and drifts. At the Ute-Ulay group no underground development work was done in 1927, but old surface buildings were repaired and new buildings built. Development work was done at the Gladiator and General Sherman adits.

JACKSON COUNTY

At the Wolverine property near Pearl, from which copper ore was shipped in 1916 and 1917, assessment work was done and repairs were made to surface buildings.

JEFFERSON COUNTY

No work was done at the Baxter Gap or at the Malachite property between Bear Creek and Mount Vernon Canyon.

LAKE COUNTY

Lake County in 1927 produced 141,075 short tons of ore, yielding gold, silver, copper, lead, and zinc, having a total gross calculated value of $2,874,116, as compared with 215,315 tons of ore and $4,104,615 in 1926. Lake County also produced 211,042 short tons of molybdenum sulphide ore in 1927 and shipped 26,828 long tons of ferruginous manganese ore to steel mills.

LEADVILLE DISTRICT[3]

GENERAL FEATURES

The metal production (except molybdenum) of Lake County in 1927 came from the Leadville district.

Classification of Leadville ores in 1927, in terms of original content

	Ore		Original analysis							
	Percentage	Short tons	Gold	Silver	Copper	Lead	Zinc	Silica	Iron	Manganese
			Ounces per ton	*Ounces per ton*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Sulphide:										
Siliceous (carrying sulphides)	2	2,419	0.752	20.86	2.84	2.35	(?)	(?)	(?)	------
Iron pyrites	5	7,131	.718	2.00	------	1.00	(?)	(?)	(?)	------
Lead	2	2,545	.143	8.50	.06	8.94	------	(?)	(?)	------
Copper (excess silica)	------	342	.249	33.04	5.85	1.75	------	(?)	(?)	------
Zinc-iron-lead	62	86,956	.011	4.26	.02	7.39	20.10	(?)	(?)	------
	71	99,393	--------	--------	------	------	------	------	------	------

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[3] For geology, history, and production see Emmons, S. F., Irving, J. D., and Loughlin, G. F., Geology and Ore Deposits of the Leadville Mining District, Colo.: U. S. Geol. Survey Prof. Paper 148, 1927, 368 pp.

Classification of Leadville ores in 1927, in terms of original content—Continued

	Ore		Original analysis							
	Percentage	Short tons	Gold	Silver	Copper	Lead	Zinc	Silica	Iron	Manganese
			Ounces per ton	*Ounces per ton*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Oxide (including low-sulphur ores):										
Siliceous gold	1	1,985	1.436	7.49	0.66	4.09	-----	55.5	19.6	-----
Siliceous silver (including old slags)	18	25,140	--------	2.75	------	3.57	(?)	32.0	28.2	------
Lead (iron excess)	3	4,490	.018	5.89	------	10.39	------	20.2	31.7	1.85
Lead (silica excess)	6	8,604	.103	4.90	.03	14.74	------	40.8	19.1	------
Iron-manganese-silver flux	1	1,152	--------	4.39	------	2.43	------	10.0	33.0	15.0
Zinc	------	311	--------	--------	------	-----	19.00	(?)	(?)	(?)
	29	41,682	--------	--------	------	------	------	------	------	------
Metal (sulphide and oxide)	(1)	(1)	(1)	(1)	------	------	------	------	------	------
	100	141,075	--------	--------	------	------	------	------	------	------

[1] Specimen gold of less than one-half ton (actually about 800 ounces) contained 575.93 ounces of gold and 168 ounces of silver.

The A. V. lead bullion-leady copper matte smelter of the American Smelting & Refining Co., formerly equipped with 8 furnaces, ran only 2 furnaces in 1927; 4 were in blast part of 1926. All the ores and concentrates treated in 1927 came from Colorado mines. As has been the situation for several years, this plant had to depend in part on silver ore drawn from slag dumps of old smelters, namely, the Bi-Metallic and Chicago; the quantity from these sources was 40,000 tons less than in 1926. The Western Zinc Oxide Co.'s Wetherill grate furnaces were idle; this plant in the past purchased zinc carbonate ore carrying as low as 14 per cent zinc. The Colorado Zinc-Lead Co.'s 200-ton selective flotation mill at Leadville was operated at nearly full capacity throughout 1927 as compared with a total for the year 1926 equivalent to 200 tons a day for 200 days; this mill had a contract to handle almost exclusively the lead-zinc-silver-iron sulphide ore of the Leadville Deep Mines Co. but was able to purchase other custom ore of similar character in limited quantities from the Fanny Rawlings, Fortune, Ibex, Louisville, New Monarch, Silver Spoon, and Yak mines. This flotation plant is equipped as follows: One Telsmith 6-E gyratory crusher, two Ruth 4 by 9 foot rod mills, one 3 by 6 foot Dorr drag classifier, one Diester concentrating table, three Ruth flotation machines (capacity, 200 tons), one Minerals Separation flotation machine (capacity, 300 tons), one American filter, and two 20 by 30 foot Dorr thickening tanks. Maximum fineness of grinding is 50 per cent minus 200 mesh. Calculations based on ore shipped from the mines indicate that the average assay of the ore sent to the flotation plant was approximately as follows: Gold, 0.0084 ounce per ton; silver, 4.34 ounces per ton; lead, 6.26 per cent; zinc, 17.96 per cent.

Some of the ores mined at Leadville were shipped for treatment elsewhere: Siliceous gold ores were shipped to the Golden Cycle cyanidation mill at Colorado Springs; iron-manganese-silver flux to Durango, Colo.; copper-silver-gold ore to Garfield, Utah; lead-silver oxidized ore to Murray, Utah; zinc carbonate ore to Canon City, Colo.; and zinc-lead sulphide ore to Coffeyville, Kans.

The lead concentrates from the Colorado Zinc-Lead Co.'s selective flotation mill went to the A. V. smelter; the zinc concentrates went either to Amarillo, Tex., or to Europe through an ore buyer at San Francisco, Calif.

MINES REVIEW

Lead-zinc-iron sulphide ores were mined at the Adams, Fanny Rawlings, Fortune, Ibex, Louisville, Silver Spoon, and Yak mines and from the Agassiz, Cyclops, Gonabrod, Greenback, Hunkadori, and Mahala claims of the Leadville Deep Mines Co. Siliceous oxidized ore was mined at the Matchless; siliceous sulphide (silver) ore at the Fanny Rawlings and Golden Eagle; and siliceous sulphide (gold and silver) ore at the Ibex. Siliceous oxidized (gold) ore was shipped from the Golden Eagle, Ibex, and Venir group. Lead sulphide ore was mined at the Fortune, Leadville Deep, New Monarch, and Yak. Copper sulphide ore was mined at the Fanny Rawlings and Ibex. Lead oxidized ore, with iron in excess of silica, was mined at the A. Y. & Minnie, Henriett-Maid of Erin, Lilian, Louisville, Nevada, Resurrection, Silver Spoon, Morning Star-Evening Star group, Stevens (of the Iron Silver Co.), and William Wallace. Lead oxidized ore, with silica in excess of iron, was mined from the Gilt Edge, Henriett-Maid of Erin, Hibschle, Highland Chief, Little Chief, Luema, Oriole, St. Louis Tunnel group, Seneca, and Yak. Iron-manganese-silver fluxing ore was mined at the Carbonate and Henriett-Maid of Erin. Iron-manganese-silver ore for steel mills was shipped from the Carbonate, Morning Star-Evening Star group, Stevens (of the Iron Silver Co.), and William Wallace. Zinc carbonate ores were mined at the Adams, Denver City, Gonabrod, Little Sliver, and Stevens (of the Iron Silver Co). Specimen gold was mined at the Golden Eagle, Ibex, and Lilian.

The Leadville Deep Mines Co., an operating, leasing, and unwatering enterprise, continued to operate a consolidated group on Carbonate Hill and in Graham Park, consisting of the company's Greenback claim, the Western Mining Co.'s holdings, the Iron Silver Mining Co.'s holdings, the Allegheny Mining Co.'s holdings, and the Empire Zinc Co.'s holdings. The group yielded the greater part of the zinc-lead sulphide ore and some of the lead oxidized, zinc oxidized, and lead sulphide ores produced in the district in 1927. The details of the unwatering of this area are described in the reports of this series for 1925 and 1926. Pumping, hoisting, and other operations are centered at two vertical shafts, 1,340 and 1,400 feet deep. In 1927 development work on the property consisted of 5,218 feet of drifts, 1,022 feet of raises, 30 feet of shaft station, and 300 feet of diamond drilling. At the Canterbury Tunnel—the community development project to prospect the northern end of the Leadville district—raises were put up near the face of the 5,000-foot adit. Lessees working through the 4-mile Yak adit produced ore from the A. Y. & Minnie, Cord, Dolly B, Dolly B-Polaris, Famous, Fortune, Habendum, Resurrection, Ruby, Sedalia, and Whitecap. The Evans-Wallower Lead Co. took over the Helena and some adjoining property in Iowa Gulch and during 1927 (180 shifts) unwatered the Helena shaft and cleaned and retimbered the shaft and old levels. Lessees continued production and development at the Ibex properties. The Morning Star-Evening Star group, operated continuously, produced iron-silver-manganese oxidized ore for steel manufacture and lead oxidized smelting ore. The Fanny Rawlings operated steadily; 125 feet of development was done on the ninth level, and zinc-lead-silver sulphide, copper-silver-gold sulphide, and siliceous copper-lead-silver-gold sulphide ores were shipped. The Vinnie lease on the Golden Eagle-Little Vinnie group sunk 250 feet of shaft, drove 800 feet of drifts, and mined several thousand tons of gold ore. The Henriette Mines Co. did 555 feet of development work on the Henriett-Maid of Erin group. Lessees drove 220 feet of drifts, 56 feet of crosscuts, and raised 95 feet at the Carbonate mine. Development work on the New Monarch group consisted of 254 feet of raises and 815 feet of drifts. At the William Wallace 100 feet of new drifts and 75 feet of upraise were driven in 1927.

OTHER DISTRICTS

Alicante, Colorado Gulch, Lackawanna Gulch, Red Mountain, St. Kevin, and Sugar Loaf districts.—All the mines were idle in 1927 except for development work on the Ten Broeck, southwest of Twin Lakes, and on the Black Beauty, on Red Mountain.

Arkansas River and tributaries placer districts.—The Derry Ranch dredge on Box Creek was idle in 1927.

Tenmile (*Climax, Fremont Pass*) *district.*—The Climax Molybdenum Co.'s mill at Climax, on Fremont Pass, in 1927 produced 1,858,228 pounds of molybdenum from molybdenite concentrates produced from 211,042 tons of ore milled. The portal of the present (November 15, 1928) lowest adit (the White tunnel) is on Bartlett Mountain, at an altitude of 12,000 feet, and is 1 mile east and 680 feet above the pass; the ore body, as at present determined by adits, drifts, raises, and diamond drilling, is not (as frequently stated) a mountain of low-grade ore but is a semiannular ore body ½ mile long, 100 to 250 feet thick, and more than 500 feet wide. The limits of the ore body are determined by commercial considerations, for the zone of deposition blends into a barren or nearly barren silicified center and into an outer rim of less and less mineralized and silicified pre-Cambrian granite. The granite was brecciated before mineralization and silicification. The Mosquito Fault lies between the mill and mine and runs in a general north-south direction. The porphyry dike that cuts through the ore body is not mineralized. The ore is now mined by the shrinkage stope method, with provision to pull the pillars and cave. The mill has a capacity of 1,000 tons a day. The ore is crushed at the mine to ½ inch by a set of 54 by 20 inch Garfield rolls, a 24 by 36 inch Allis Chalmers Superior jaw crusher, and a 4-foot Symons cone crusher. At the mill are three 6 by 6 foot and two 6 by 10 foot Allis Chalmers ball mills, six 150-ton Model C Dorr classifiers, 19 Callow flotation machines (capacity, 1,000 tons), 1 Oliver filter, 8 steam-heated pans for heating, one 9 by 10 foot Dorr thickening tank. The mill is on the Colorado & Southern narrow-gauge branch, 14 miles from Leadville, and is connected with the mine on Bartlett Mountain by a 1-mile aerial tram. The ore contains as high as 2 per cent of pyrite, but practically all of it is dropped in the flotation machines. The mine was operated 345 days and the mill 365 days in 1927.

LA PLATA COUNTY

La Plata County includes the California, Cave Basin, Needle Mountain, and Oro Fino mining districts, and the American Smelting & Refining Co.'s lead bullion-leady copper matte smelter is at Durango. This smelter is equipped with one blast furnace and handles mainly concentrates, but also whatever ore is offered from Dolores, La Plata, Ouray, San Juan, and San Miguel Counties, with occasional lots of ore from Mineral, Lake, and Eagle Counties. The Read-Coolbaugh sulphating plant is also at the smelter; it was built in 1923 to remove the zinc from the concentrates, as nearly all of the San Juan region concentrates for years have carried sufficient zinc to make the charge 10 per cent and upward. The regional supply of silica has long been insufficient.

Two gold mines, the May Day at Hesperus and the Gold King at La Plata, produced 613 tons of ore in 1927, yielding $23,103 in gold and 8,912 ounces of silver, valued at $5,053; the total value for the county output was $28,156 as compared with $8,145 in 1926.

California (or La Plata) district (Hesperus, La Plata).—The May Day is a well-known former producer. In 1927 most of the work done was for ventilation. The ore is found in an inclined limestone bed. A 550-foot underground shaft extends from one of two old adits on the same level. At a lower level an 810-foot crosscut adit extends to the bottom of the 550-foot shaft, and a crosscut 1,100 feet long cuts the vein, then a 63° upraise 140 feet high connects with a 467-foot shaft down from the level of the other upper adit. The development work in 1927 consisted of sinking 467 feet of the 63° incline and raising 100 feet on the incline and of 200 feet of drifts. From the bottom adit there is 157 feet of drifts north on the vein and 80 feet south. At the Gold King group the development work at the end of the year consisted of 900 feet of adits, 1,000 feet of drifts, and 375 feet of raises, of which 766 feet of drifts and 100 feet of raises were done in 1927. The greater part of the year 1927 was spent in construction of the camp buildings. In addition, the old Bonnie Girl mill building was repaired and remodeled. The mill equipment, as completed near the end of the year, consisted of 1 Allis Chalmers 4 D crusher, 50 Allis Chalmers (1,000-pound) stamps, screens, 1 Colorado Iron Works 5 by 5 foot ball mill, 1 Akins 36-inch classifier, 2 No. 5 Wilfley tables, 1 Denver Sub A 6-cell flotation machine, 1 Callow-type flotation machine, 1 Portland 2½-foot filter, and 2 Dorr 8-foot thickening tanks. Power is supplied by both a hydroelectric and a steam electric plant. The minerals in the ore are gold-silver tellurides, galena, pyrite, and sphalerite. Assessment work was done at various other properties in the California district.

Mount Runlett (or Cave Basin) district (20 miles north of Bayfield).—Development work was done in the Cave Basin district.

Needle Mountain district (Tacoma).—No work was done in the Needle Mountain district.

Oro Fino district.—No work was done at the two former producers, the Neglected and the Oro Fino.

LARIMER COUNTY

Cameron Pass district (Home).—A little development work was done at the prospect of the Cameron Pass Mining Co. before abandonment in April.

Livermore district.—Assessment work was done in 1927 at the Iron King prospect.

MESA COUNTY

Sinbad district.—A 1-ton lot of copper-silver ore was shipped from the Precipice prospect, 60 miles west of Whitewater.

MINERAL COUNTY

The output of recoverable metals from Mineral County mines (nearly all near Creede) in 1927 was $246 in gold, 214,850 ounces of silver, and 75,286 pounds of lead from 3,592 tons of dry siliceous silver ore, of which 1,206 tons were sold to the Golden Cycle cyanidation mill at Colorado Springs and 2,386 tons to the Leadville smelter. The Withrow-Commodore lease, on the Commodore mine, was the principal operator and shipper. This leasing company drove 100 feet of winzes, 300 feet of raises, 600 feet of drifts, and 400 feet of crosscuts in 1927. The Morgan & Sloan lease, on the New York and Last Chance & Volunteer groups, shipped several cars of relatively high-grade silver ore to both the Golden Cycle mill and the Leadville smelter. This leasing company drove 300 feet of drifts and one raise. Development work at the Equity group by the North Amethyst Mining Co. resulted in the shipment in 1927 of several cars of highly siliceous silver ore. At the end of 1927 this property was developed by a 150-foot incline shaft and 1,600 feet of adits, raises, crosscuts, and drifts, of which 60 feet of shaft, 56 feet of drifts, 80 feet of crosscuts, and 100 feet of raises were driven in 1927. Development work was done in 1927 at the Bachelor, Chama, and Monon.

MOFFAT COUNTY

Four Mile Creek district (*Baggs, Wyo.*).—Two small sluicing operations on Four Mile Creek, Moffat County, yielded 23.03 ounces of gold. The fineness of the gold bullion as marketed varied from 0.948 to 0.952 gold and from 0.047 to 0.046 silver.

MONTROSE COUNTY

Small sluicing operations on bench gravels of Dolores and San Miguel rivers below Naturita, Montrose County, yielded 4.45 fine ounces of gold. The fineness was 0.784 gold and 0.213 silver.

OURAY COUNTY

Red Mountain district.—Eight mines in the Red Mountain district in 1927 produced 4,836 tons of ore, yielding $2,148 in gold, 23,097 ounces of silver, 61,145 pounds of copper, 191,381 pounds of lead, and 93,000 pounds of zinc, with a total gross calculated value of $41,263 as compared with $71,727 in 1926. Lessees on the Barstow mine operated throughout the year but ran the 50-ton stamp gravity concentration mill only a few weeks in the summer. The product was a lead-silver-gold concentrate. The lessees shipped one small car of lead-silver ore and one car of zinc-lead-silver-gold ore. A car of lead-silver-gold ore, containing some zinc, was shipped from the Guston mine to the lead smelter at Midvale, Utah. Several hundred tons of zinc-lead-copper-silver-gold sulphide ore from the Beaver-Belfast group was sold to the International selective flotation custom mill at Rico, Colo. A variety of ores—copper-silver-gold smelting ore, lead-silver-gold smelting ore, and copper-lead-silver-gold smelting ore—was shipped from the Hero mine to the Salt Lake Valley, Utah, smelters. Several thousand tons of dump material from the Yankee Girl was concentrated at the Sutton flotation mill at Bear Creek, near Ouray. The product, a copper-silver concentrate, was shipped to the International copper plant at Tooele, Utah. Several cars of copper-lead-silver-gold ore from the San Antonio mine were shipped to the Garfield smelter, Garfield, Utah.

Sneffels district.—Lessees on the upper workings of the famous Camp Bird mine (reopened in 1926 after an interval of no production since June 30, 1916) completed a 50-ton amalgamation-gravity concentration mill at the upper adit in Imogene Basin and operated it at part capacity for 177 days. The flow sheet is: Crushing in Blake crusher, grinding in two Marcy mills followed by plate amalgamation, and concentration on three No. 5 Wilfley tables. Development at the mine consisted of 210 feet of raises in 306 working days. The products of the mill were gold-silver bullion, shipped to the Denver Mint, and concentrates chiefly valuable for gold but containing 20 ounces of silver to the ton and some copper, lead, and zinc, shipped to Leadville, Colo., and to Midvale, Utah. Specimen gold was shipped to the Denver Mint from the Governor mine.

Uncompahgre district (Ouray).—Several hundred tons of lead-silver-gold ore, containing also much zinc and some copper, was shipped from the Bachelor mine to the Leadville smelter. Before the mine was closed down on July 19, 1927, openings broken in development work totaled 1,044 feet of drifts and 222 feet of crosscuts. The property is opened by a 2,050-foot adit. At the American Nettie-Jonathan-Wanakah-Pony Express group the Mutual Gold Mines Co. drove 1,450 feet of drifts and 400 feet of raises. This company also acquired the Wanakah mill on Uncompahgre River and connected it with an aerial tram from the American Nettie camp on the ledge high above the river. The company remodeled the old mill; the ore was crushed to ½ inch, then to Marcy rod mill, classifier, the oversize to ball mill, and then to five amalgamation plates, the plate tails to 8-cell Ruth flotation machine and the flotation tails to four Wilfley tables. In the course of development several cars of silver-lead ore were shipped to smelter, and several hundred tons of dump ore was sent to the mill. The mill products were gold bullion and gold-silver concentrate. The tram was completed in August, but on October 29 a fire in the blacksmith shop at the American Nettie spread to the tram terminal and destroyed it. The Sutton mill, at the mouth of Bear Creek south of Ouray, was started in 1926 and completed early in 1927; it was operated until September 28 on ore from the Sutton group, on the face of Mount Hayden, and on dump ore from the Yankee Girl. The equipment of the mill consists of the following: 1 Blake crusher, 1 Colorado Iron Works ball mill, 1 Akins classifier, one 8-cell Minerals Separation flotation machine, 1 drum-type filter, 1 Dorr thickening tank, 1 Oliver vacuum pump, and 1 small compressor. The product was copper-silver-gold concentrate. One car of gold-silver ore was shipped to the Leadville smelter from the Speedwell group. This ore was packed from the mine to the railroad on mules.

PARK COUNTY

Buckskin district.—One small lot of dry gold ore from the Paris-Excelsior group was treated by amalgamation, resulting in a small product of gold amalgam. With a force of three to five men working throughout the year, the main adit of the "Sweet Home" property was driven an additional 581 feet, and a car of zinc-lead-copper-silver-gold ore was extracted and shipped to the Leadville smelter.

Consolidated Montgomery district.—One small narrow-gauge car of siliceous gold-silver ore from the Great West-Little Fannie group was shipped to the Leadville smelter. One narrow-gauge car of lead-silver ore was shipped from the Weber group to the Leadville smelter. At the Russia mine, on Mount Lincoln, drifting, sinking, and raising done in 1927 amounted to 473 feet.

Hall Valley district (*Webster*).—Several narrow-gauge cars of lead-copper-bismuth-gold-silver ore were shipped from the La Clede-Missouri group to the Midvale, Utah, smelter. The bismuth was made a part of the credit computation on the settlement. The mine is opened by five adits, 100 to 550 feet long. About 100 feet of development work was done in 1927.

Lake George district.—A 6-ton lot of low-grade lead-silver siliceous oxidized ore was shipped from the Black Prince mine in the Lake George district.

Mosquito district.—Development work was continuous up to September at the Lulu, Flora A., Fraction, and Reconstruction group, by the London Gold Mines Co., from what is called the South adit. During this time 275 feet of drifts, 470 feet of raising in the shaft, and 223 feet of crosscuts were broken. Thereafter dry gold ore carrying a little lead was shipped. The ore was shipped both to the Leadville smelter and to the Golden Cycle mill. During the year the Bagdad Smelting & Refining Co., lessee, mined old stope material from levels above the North adit of the London mine. This material was treated in the "North London" flotation mill and yielded a lead-gold-silver concentrate.

PITKIN COUNTY

The total gross calculated value of the silver, lead, and zinc recovered from ores mined in Pitkin County in 1927 was $250,804, as compared with $446,043 in 1926. All the ore mined in 1927 was shipped to smelters.

Roaring Fork district (*Aspen*).—Old stopes of the Spar Consolidated group contributed several thousand tons of lead-silver ore. Lessees on the Della S group mined limey dry silver ore (with some lead) and siliceous lead-silver ore. Several cars of dry silver ore (with some lead) were shipped from the Hope property. One car of lead-silver oxidized ore was shipped from the Winnie claim. Lessees on the Percy La Salle group mined 1,000 tons of lead-silver oxidized ore. The Park Tunnel Mining & Milling Co. shipped several hundred tons of lead-silver oxidized ore. Several cars of limey lead-silver oxidized ore were shipped from the Pride of the Hills. Lessees on the Smuggler and Durant group shipped several hundred tons of lead-zinc silver sulphide ore and more than 18,000 tons of limey lead-silver ore.

RIO GRANDE COUNTY

Summitville district.—Lessees on the Little Annie mine, at Summitville, in 1927 continued to ship specimen gold in truck lots and also shipped two or three carloads of ore carrying 3 to 5 ounces of gold to the ton to the Golden Cycle mill. One hundred and thirty-seven tons of ore returned $117,826.49 in cash, after hauling, freight, and treatment costs were deducted. The total dividends for 1926 and 1927, after royalty and other expenses were paid, were $145,000. In 1927 development work consisted of 350 feet of drifts and 60 feet of raises.

SAGUACHE COUNTY

The total gross calculated value of metals recovered from ore mined in Saguache County in 1927 was $1,321,640 as compared with $578,513 in 1926.

Kerber Creek district (*Bonanza*).—The Rawley flotation mill was operated steadily at an average of 300 to 325 tons daily on ore from the Rawley mine and on small custom lots from other properties in the Kerber Creek district. The mill, remodeled in 1926, is equipped as follows: 1 Gates gyratory crusher, 1 set of rolls, two 8-foot Hardinge mills, 2 Dorr classifiers, 2 Minerals Separation Sub A flotation machines of 12 cells each, several Allen cleaning and roughing flotation machines, 1 Oliver filter, and 2 Dorr thickening tanks.

The concentrates, lead-copper-silver-gold [zinc], are carried by a 7¼-mile aerial tram to storage bins at Shirley on the Denver & Rio Grande Western Railroad's narrow-gauge Salida-Montrose branch. From Shirley the concentrates go to Salida, where they are transferred to broad-gauge cars for movement to the Leadville smelter. The Rawley mine is opened by an adit 6,600 feet long. Development work at the mine in 1927 totaled 2,459 feet.

Custom ore was received at the Rawley mill from the Antoro, Baltimore, Empress Josephine, Erie, Little Jennie, Now What, Paddy Doyle, Paragon, Rico, St. Joe, Sosthenis, Vienna, and Wheel of Fortune claims. Smelting ore from the Baltimore, Golden Wave, Hanover, Rico, and Wheel of Fortune was shipped out of the district. Development work at the Bonanza-Cocomongo group totaled 1,763 feet in 1927.

SAN JUAN COUNTY

Animas district (*Silverton*).—The Animas district includes the area in the vicinity of Silverton and east of the Animas River from Silverton to Middleton. One small lot of concentrates from the Iowa Tiger mill and small lots of smelting ore from the Aspen, Bettie M., Champion, Little Fannie, Little Nation, Queen City, and Silver Lake mines were shipped to the Durango smelter. A leasing company on the Iowa Tiger did 100 feet of drifting and 75 feet of winzing in 1927. The Iowa Tiger mill is equipped with 1 Blake crusher, 2 trommels, 2 sets of rolls, 2 Chile type mills, 6 No. 5 Wilfley tables, and 2 flotation machines; the concentrates produced were lead-copper-silver-gold. The ore shipped from the other mines was mostly lead-silver-gold or lead-copper-silver-gold. At the Shenandoah-Dives Syndicate group, consisting of the Shenandoah-Dives, North Star, and Mayflower groups, 2,523 feet of drifts, raises, and crosscuts and 327 feet of deep drill holes were driven.

Eureka district (*Eureka*, *Silverton*).—Producing mines in 1927 in the Eureka district were the Sunnyside, at Eureka, and the Robert Bonner, near Red Mountain. The Sunnyside 825-ton selective flotation plant of the United States Smelting, Refining & Mining Co. was operated 365 days in 1927. This plant was one of the first (in 1912) to use selective flotation in the treatment of a complex low-grade zinc-lead-copper-iron-silver-gold ore. In 1927 the milling practice[4] was about the same as in 1926. A high-grade zinc concentrate carrying also lead, copper, silver, and gold was shipped to Oklahoma-Texas zinc-retort plants (residues from the zinc retorts going to El Paso, Tex.); a high-grade lead concentrate carrying more than half the recovered gold and silver went to the Durango smelter; and a zinc-lead middling carrying more gold but less silver than the zinc concentrate was shipped to the Read-Coolbaugh sulphating plant at the Durango smelter, where the soluble zinc sulphate was leached out, the residue being sent to the lead furnaces. Some of the zinc sulphate was sold to flotation plants throughout the United States and some was sent to Amarillo, Tex., to be made into slab zinc after first being made into a zinc oxide. The flotation mill at Eureka is connected with the mine by a 17,000-foot aerial tram. Crushing is done both at the mine and at the mill. The mining is done by the shrinkage-stope method. Development work in 1927 totaled 6,660 feet.

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[4] Robie, E. H., Selective Lead-Zinc Flotation at Sunnyside: Eng. and Min. Jour., vol. 121, 1926, pp. 542, 757–762.

The equipment of the Sunnyside flotation plant in 1927 was as follows: 2 Gates No. 6–K gyratory crushers (at the mine), 2 Ferrel 13 by 31 inch jaw crushers, 4 Denver Engineering Works 5 by 14 foot tube mills, 3 Marcy No. 86 ball mills, 6 Dorr (both C and D) rake classifiers, 11 No. 6 Wilfley tables (used only for control), 30 Minerals Separation 24-inch Standard flotation machines (10 machines as lead roughers, 20 machines as zinc roughers), 6 Minerals Separation 18-inch Sub–A flotation machines (lead and zinc cleaners), 3 Portland filters (12 by 3½ foot for lead, 12 by 9 foot for zinc, 12 by 5 foot for middlings), and 3 Dorr 28 by 9 foot thickening tanks (1 each for lead, zinc, and middlings).

SAN MIGUEL COUNTY

The mines of San Miguel County in 1927 produced 312,490 tons of ore, yielding $922,806 in gold, 905,949 ounces of silver, 219,443 pounds of copper, 9,647,540 pounds of lead, and 708,000 pounds of zinc, with a total gross calculated value of $2,118,333, as compared with 478,116 tons of ore and $2,971,182 in 1926.

Iron Springs district (*Ophir*).—The Ophir district in 1927 produced 44,494 tons of ore, yielding $14,906 in gold, 246,873 ounces of silver, 96,435 pounds of copper, and 3,096,238 pounds of lead, with a total gross calculated value of $362,579, as compared with $387,554 in 1926. The principal producing mines were the Carbonero and the San Bernardo. Some lead-silver-copper-gold smelting ore was shipped from the Carbonero mine to the Durango smelter, but the greater part of the ore mined was dry silver ore, carrying some lead, and was milled at the 45-ton flotation mill on the property. The ore was nearly all sulphide; it was crushed in a Universal crusher, then went to a Ruth 3 by 9 foot rod mill, and then to an 8-cell Ruth flotation machine supplemented by 4 Deister-Plato tables (1 used as a rougher, 2 as slimers, and 1 as a pilot). The product was a lead-copper-silver-gold concentrate. The mill was built in 1924. It is connected with the mine by a 3,300-foot aerial tram. The San Bernardo dry silver ore, carrying some lead, was milled at the Valley View flotation mill, built in 1920, at Matterhorn, 2 miles south of Ophir. The equipment consists of 1 Gates gyratory crusher, 2 Allis Chalmers 6 by 5 foot ball mills, 1 Dorr duplex classifier, 1 Minerals Separation 12-cell flotation machine, 1 American continuous filter, and 1 agitation tank. The mill was operated nine months; the product was a lead-copper-silver-gold concentrate. The San Bernardo mine is opened by five adits, totaling 9,500 feet. Three hundred feet of development work was done in 1927. The Silver

Bell mine was operated all year, 300 feet of drifts being driven and one lot of lead-silver ore being shipped. A car of copper-silver-gold ore was shipped from the Crown Point mine. The old mill on the Butterfly-Terrible mine was destroyed by fire in May, 1927. Construction was started on a new mill to replace the old one. At the Suffolk group, opened by a 2,043-foot adit, the timbering was repaired and development work was done.

Lower San Miguel district (*Sawpit*).—One car of zinc-lead-silver-gold sulphide ore was shipped from the Lizzie prospect to the custom mill at Bauer, Utah.

Upper San Miguel district (*Telluride*).—Five mines in the Upper San Miguel district in 1927 produced 267,971 tons of ore, yielding $907,849 in gold, 659,030 ounces of silver, 123,008 pounds of copper, 6,548,556 pounds of lead, and 703,000 pounds of zinc, with a total gross calculated value of $1,755,184, as compared with 449,525 tons of ore and $2,583,628 in 1926. The Smuggler Union mine was the only important producer, as the Tomboy closed down in January, 1927. The Alta 300-ton mill was operated for a few weeks at part capacity; the equipment consists of 1 Allis Chalmers crusher, 2 Marcy ball mills, 2 Dorr classifiers, 6 No. 6 Wilfley tables, 7 J. B. flotation machines, 3 homemade flotation machines, 1 Minerals Separation flotation machine, 1 Colorado Iron Works filter, and 2 Dorr thickening tanks. No development work was done at the Alta mine in 1927. A lessee on the Black Bear mine shipped zinc-lead-copper-silver-gold-iron sulphide ore to the selective flotation custom mills of the International Smelting Co. at Rico, Colo., and at Tooele, Utah.

The Smuggler Union Mining Co.'s 650 to 800 ton mill, which combines stamp amalgamation, gravity concentration, and flotation, was operated steadily in 1927 until a fire on October 20 destroyed the surface workings at the Pennsylvania adit. This accident curtailed production until the internal shaft could be converted from a man-hoisting to an ore-hoisting unit to make the ninth level the main outlet. The history, production, geology, mining methods, and metallurgical methods and results at this mine, which has had a life of 52 years, are given in an article by the company's president and general manager,[5] and details of grade of ore mined and costs are quoted as follows:

> The Smuggler ore is characteristically a gold-silver ore with a little lead. The upper levels showed shoots of very rich ore, containing particularly free gold. As late as 1910 crude ore assaying several hundred ounces of silver per ton was regularly sacked and shipped, and several times within my recollection pockets of gold ore were encountered on which guards were posted. These occurrences have passed into history, unfortunately; but occasionally, even now, very rich but small pockets are encountered even at the lowest levels.
>
> The characteristic mill ore of the Smuggler vein contains now about 0.12 ounces gold and 6 to 8 ounces of silver with about 1 per cent lead. The Flat vein also was richer near the surface, but its lead content has always been greater than that of the Smuggler ore. Fortunately, its gold content is somewhat higher also. Characteristic mill ore runs 0.20 gold, 1 to 4 ounces silver and 1.5 per cent lead.
>
> The process at present used is simple, since no selective separation is made or, indeed, is feasible. A simple oil mixture with a small addition of xanthate is added to the product as it comes from the concentrator, which is then passed through a succession of cells of Callow type. The resulting concentrate is pumped back to two cleaner cells. After thickening, this product is mixed with the concentrate from the stamp mill, dewatered, and filtered on Portland filters. The cake passes over belts to the bins, whence it is mechanically loaded into

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[5] Livermore, Robert, Prolonging the Life of the Smuggler Union Enterprise: Eng. and Min. Jour., vol. 125, Mar. 31, 1928, pp. 525–532.

cars for shipment to Durango. From two to three cars a day, equivalent to about 2,000 tons of concentrates a month, are made. The amalgam is retorted and the bullion sent to the mint. This product formerly constituted about one-third of the gross production but now is somewhat less.

Considering the somewhat complex nature of the ore and the comparatively simple treatment accorded it, the percentage of extraction of the metals is satisfactory. Based on the usual method of estimation, using net smelter and mint returns and calculated values of the tailings, 90 per cent of the gold and lead and 80 per cent of the silver is recovered. The concentration ratio is quite uniformly 10 to 1.

From July, 1925, all efforts have been directed to increase of production to the full capacity of the mill, and at the same time to maintain the grade of the ore at a profitable level. This was not done at once, and there have been many setbacks. The story is summarized in the figures given in annual reports of the company for the fiscal years ended April 30, 1925, 1926, and 1927, which follow:

	1925	1926	1927
Gross extracted value, per ton	$6.25	$6.06	$6.23
Freight and treatment	1.08	1.33	1.33
All other expenses	4.88	4.97	4.65
Total cost	5.96	6.30	5.98
Tonnage	177,720	218,449	253,975

The following summary shows the operating costs for a typical year. The costs given include every expense at Telluride, including local taxes, insurance, and construction, and exclude only Boston office expenses, depletion, and depreciation:

Ore extraction	Per short ton
Mining	$1.194
Timbering	.460
Hoisting	.057
Tramming	.766
Cable tramway	
Smuggler tramway	.131
Pennsylvania "	.085

Ore reduction	Per short ton
Crushing	$0.092
Flotation plant	.368
Concentrating mill	.610
General charges	.398
Development	.396
Construction	.037
Grand total	4.594

The Tomboy Gold Mines Co. (Ltd.) continued operation for about a month in 1927. Later in the year the property was sold to local capitalists, who, under the name of the Tomboy Mines Co., put up a 287-foot raise and shipped 175 tons of lead-silver gold-bearing material from a clean-up of the mill.

SUMMIT COUNTY

The total gross calculated value of metals recovered from Summit County lode and placer mines in 1927 was $532,952 as compared with $634,140 in 1926.

Breckenridge district.—The total gross value of the combined output of lode and placer mines in the Breckenridge district in 1927 was $505,133. A Universal power shovel on a caterpillar was operated from June 12 to September 12 at the Bemrose-Bostwick placer in Hoosier Gulch, near Hoosier Pass. The gravel dug up—1,126 cubic yards—was dumped over grizzlies and into sluice boxes, where a gold amalgam averaging 0.747 gold and 0.177 silver was recovered. The Blue River Placer Mining Co.'s electrically driven dredge of 88 buckets, each with a capacity of 8½ cubic feet, handled 988,527 cubic yards in 4,579 hours—May 1 to December 31. The Mekka Placers hydraulic mine was operated four months. Small sluicing operations were conducted at the Mickie, Shakespeare, Swan, and Washington placers.

A few hundred tons of dry gold and silver ore from the Detroit mine was milled by amalgamation and concentration at the Extension mill, and one car of lead-silver-gold ore was shipped from the Detroit mine to the Leadville smelter. Development was continuous at the Royal Tiger property, where 3,020 feet of drifts, 351 feet of crosscuts, and 1,159 feet of raises were opened. The Royal Tiger experimental mill was operated four months; the product was a lead-silver-gold concentrate. A small lot of lead-silver-gold siliceous oxidized ore was shipped from the Sure Thing property to the Leadville smelter. The Wellington Mines Co. operated the Wellington mine and 100-ton jigs, table, and magnetic separation mill until April 1, 1927, when the operation of the property was taken over by the Wellington Mines Leasing Co. This company rebuilt the concentrator to a 125-ton selective flotation mill and started the new mill August 23, operating it until November 28, when all operations were suspended owing to the decline in prices of metals. The flow sheet of the old mill was crushing to one-fourth inch by jaw crusher and rolls. Plus 4 mesh, 6 mesh, and 12 mesh went to Harz jigs. Minus 12 mesh went to hydraulic classifier to tables. The zinc product was roasted, then went to magnetic separators where the iron was removed, and again to tables. The new mill flow sheet is crushing by jaw crusher and rolls to one-half inch, then to ball mill and Dorr classifier until 10 per cent minus 80 mesh. One 12-cell 18-inch Minerals Separation flotation machine is used to make lead concentrates, then the pulp goes to two conditioning tanks, and then to a 12-cell 18-inch Minerals Separation flotation mill for zinc concentrates. The lead concentrate and the zinc concentrate each goes to Wilfley tables to thickener to American filter.

Montezuma district.—Two mills were operated at Montezuma part of the year—the Pennsylvania gravity concentration mill making lead concentrates and the new St. John flotation mill making a lead and a zinc concentrate. Only 70 feet of development work was done at the Bell & California group, from which 31 tons of lead-silver ore were shipped to the Leadville smelter. A small lot of lead-silver smelting ore was shipped from the Windsor claim also. At the Hall group 400 feet of development was done, at the Hunki Dori 300 feet, at the Marlin 200 feet, and at the New York 800 feet.

Tenmile district (*Kokomo, Robinson, Frisco*).—Several cars of siliceous lead-silver-gold sulphide ore were shipped from the Wilfley group at Kokomo to the Leadville smelter. One car of siliceous lead-silver-gold oxidized smelting ore was shipped from the Etta property at Frisco. Fifty feet of winze and 50 feet of drift were opened in 1927 at the King Solomon 6,000-foot adit at Frisco.

TELLER COUNTY

Mine and dump ore, concentrates, slags, clean-ups, and stolen specimen gold from the Cripple Creek district aggregated in recovered gold to United States mints and to smelters 160,000.52 fine ounces, valued at $3,307,505 as compared with $4,436,012 in 1926; and 25,344 ounces of silver as compared with 25,609 ounces in 1926. The Golden Cycle roast-amalgamation-cyanidation mill at Colorado Springs was operated steadily at 862 tons a day, mainly on ores from the Cripple Creek district. Gold ore in 1927 was also received from Boulder, Clear Creek, Gilpin, Lake, and La Plata Counties and silver ore from Mineral County, but the total tonnage from these sources was only 12,312 tons for the year. The flow sheet of the main Golden Cycle mill has not been materially changed since its last description by Blomfield and Trott.[6] The flow sheet is as follows: The ore goes to a sampling mill and then to storage bins for different classes of ore. The ore from the storage bins is divided between one Hardinge ball mill and five Schmidt Kominuters operating in closed circuit with Hum-mer screens. The screen undersize goes to nine coal-fired 115 by 15 foot Edwards Duplex roasters. The roaster product goes to seven Evans-Waddel 6-foot Chilean mills grinding in the alkaline-cyanide mill solution. Each Chilean mill is followed by two blanket concentrating tables, and the tailing from the blanket tables goes to 15-foot Dorr Bowl classifiers. The sand product of the classifiers goes to eleven 50 by 6 foot leaching tanks using a counter-current decantation leaching system. Sand tailings are flushed to the tailings dump. The slime product from the classifiers goes to the slime leaching plant using thickeners and agitators. The development and application of the Golden Cycle "Superthickener" (now called Hardinge Superthickener) in the slime leaching plant has been described by Noel Cunningham.[7] Tailings from the slime plant are filtered on two stationary 86-leaf Moore filters. Gold solution from both leaching plants is clarified, deoxidized in a Crowe vacuum system, and precipitated in cascade-type zinc boxes. Merrill zinc presses are used in the clean-up. But in 1927 a Marcy ball mill, Dorr classifier, and Dorr thickener and agitating tanks were installed to treat ores from districts other than Cripple Creek (ores requiring no roasting) in a separate circuit, the gold solution joining the solution from the sand and slime plants.

The Portland-Independence nonroasting gravity concentration-selective flotation-cyanidation mill at Victor was operated continuously in 1927 at 523 tons of mine and dump ore a day. A brief review of the metallurgical treatment of Cripple Creek ores from 1892 to 1927, with special reference to the five different reduction plants (during that period) of the Portland Gold Mining Co. and a detailed description of the 1927 operation of the Portland-Independence mill, has been written by J. M. Tippett.[8] The flow sheet (and equipment) of the Portland-Independence mill is as follows: The coarse ore is drawn from the receiving bins to two 7½-D Gates crushers, then into two 20 by 72 inch roll sets, and through a sampling unit to six fine-ore bins of 2,500 tons capacity. The fine ore is fed to six Chilean mills followed by six Akins classifiers. The classifier sands are advanced to six 6 by 6 foot ball mills operating in closed circuit with six additional Akins classifiers. Alkaline-cyanide mill solution (0.25 pound cyanide and 1 pound CaO per ton) is used in the fine-grinding machines. The overflow from the 12 classifiers is advanced to the four 8-cell Ruth flotation machines where 0.3 pound of a reagent mixture of 90 per cent of fuel oil and 10 per cent of pine oil is added per ton. A high-grade flotation concentrate, amounting to about 1 per cent of the total ore treated, is made. Flotation tailings are tabled with 34 rougher and 11 finishing tables, making a concentrate which joins the flotation concentrate, a middling which is returned to the ball mill circuit, and a tailing which is advanced to the low-grade thickener tanks. The combined flotation and table concentrate is thickened (overflow solution used in tabling) and charged in batches to a 5 by 14 foot tube mill with 2-inch grinding balls. Two tons of alkaline-cyanide solution per ton of concentrate is added and the mill sealed and rotated for one and one-half hours. It is claimed that the reducing action of the evolved hydrogen effectively conditions the concentrate for subsequent dissolution in cyanide solution. The concentrate is discharged to three high-grade agitation tanks (in series), and the solution (and pulp), after agitation, is returned to the main mill circuit, joining the flotation tailing. It eventually joins the table tailing and is advanced to the low-grade thickening and agitation tanks.

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[6] Blomfield, A. L., and Trott, M. J., Roasting for Amalgamating and Cyaniding Cripple Creek Sulpho-Telluride Gold Ores: Trans. Am. Inst. Min. Eng., vol. 60, 1919, pp. 118–132; The Golden Cycle Cyanide Plant: Chem. and Met. Eng., vol. 19, No. 12, 1918, p. 796

[7] Cunningham, Noel, The Golden Cycle Superthickener and Clarifier: Eng. and Min. Jour., vol. 119, No. 22, May 30, 1925, pp. 905–907.

[8] Tippett, J. M., Flotation of a Gold Ore in a Cyanide Solution: Eng. and Min. Jour., vol. 124, July 30, 1927, pp. 181–183.

The remainder of the mill equipment consists of 4 Merrill slime presses, 1 Crowe vacuum system, 2 zinc-dust feeders, 6 Merrill zinc presses and accessory pumps, sumps, and tanks.

In the annual printed report of the Portland Gold Mining Co. for the calendar year 1927 the manager of the Independence mill reports on its operation as follows:

> The tonnage and average value of the ore accepted for treatment during the year was slightly less than for the year 1926. The lower mill head is accounted for in part by reason of a considerable tonnage from custom dumps, which product contained a gold content of little more than operating costs. The bullion and concentrates sold during the year returned a total of $660,292.68, which return reflects an extraction of 92.6 per cent. This extraction, based upon actual recovery, is a material improvement over any previous operating year.
>
> In last year's report you were advised that a flotation method had been devised by the writer, after years of study and experimentation, which method is covered by patent and would be a factor of material consequence during the year 1927. To permit this improved practice, and by your direction, two Ruth double-cell flotation machines were installed. This new improvement in the treatment of a gold ore was started March 11, 1927, and has continued in successful operation since. In addition to the above treatment, a method was devised and adopted for the treatment of the raw flotation concentrates from the flotation machines, which replaces the old roasting method of treating this product preparatory for cyanidation. This has resulted in a substantially increased metal saving, in addition to the saving of smelter treatment and freight charges, and all value is now reduced to bullion at your Independence Mill and shipped to the United States Mint at Denver.

MINES REVIEW

Mineral Hill.—Several hundred tons of ore was shipped from the Plutocrat prospect, opened by an adit 300 feet long and a shaft 35 feet deep.

Carbonate Hill.—The Jay Gould Mining Co. shipped 109 tons of ore from the Kittie Wells.

Poverty Gulch.—Several thousand tons of low-grade ore was shipped from the dump of the El Paso-Gold King-Rosetta group. Dump ore was shipped from the C. O. D. The Stratton Lease repaired the surface plant at the Abe Lincoln and later shipped from the property.

Hoosier Pass.—The Cudahy Gold Mining Co. shipped several cars from the Hoosier.

Tenderfoot Hill.—The Reclamation Metal Mines Co. operated the Black Diamond group and Sangre de Christo adit. A new 30-horsepower hoist, new cable, new bell lines, and 8,000 feet of electric wiring for electrical firing were installed in 1927. Development work resulted in sinking 108 feet, drifting 150 feet, and crosscutting 50 feet; 448 tons of ore was produced. A few cars of dump ore were shipped from the Queen Bess.

Globe Hill.—The Stratton Lease prospected for ore on the Deerhorn by diamond drilling.

North slope of Ironclad Hill.—The Osten Leasing Co. did 865 feet of development work and shipped several thousand tons of ore from the Jerry Johnson mine. Lessees produced ore from the Damon (Axtel), Londonderry, and W. P. H. properties of the United Gold Mines Co. The Queen Metals Co. produced ore from the Forest Queen.

Gold Hill.—From the Midget dump 12,000 tons of ore was shipped to the Golden Cycle mill. During the first three months of 1927 several hundred tons of ore was mined from the Keystone and Lucky Corner lodes of the Index Mines (Ltd.). Nearly 1,000 tons of dump ore was shipped from the Matoa.

Raven and Guyot hills.—Producing mines were the Cresson, Doctor-Jack Pot dump, Elkton, Mary McKinney, and Queen. The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended August 31, 1927 (dated January 10, 1928), says:

> During the fiscal year 104,145 dry tons of ore were shipped of a gross value of $1,351,056.50, averaging $12.97 per ton; the returns, less transportation and treatment, were $860,149.16, giving the ore a net value of $8.26 per ton. The company received as additional income the sum of $16,635.02 interest on bank deposits, and the sum of $215.51 net royalties from 500 tons of ore shipped by lessees, also miscellaneous income of $90.71, making a grand total of $877,090.40, with total expenses of $572,371.39, resulting in a net gain from operations of $304,719.01. The total cost per ton of ore produced was $5.50. This is a decrease of 75 cents per ton over 1926.
>
> You will note in our company's production of 104,145 dry tons, with an average return of $8.42 per ton, our entire cost was $5.50 per dry ton, resulting in a net profit of $2.92 per ton.
>
> Total cash at the close of the fiscal year ending August 31, 1927, was $847,532.13.
>
> *Costs at the Cresson mine, fiscal year ended Aug. 31, 1927*
>
> | | Per ton |
> |---|---|
> | General expense | $0. 002 |
> | Taxes | . 250 |
> | Insurance | . 115 |
> | Salary officers | . 086 |
> | Colorado Springs office | . 088 |
> | Mining operations (including mine management and engineering) | 4. 900 |
> | Dante operations | . 059 |
> | | 5. 500 |
>
> Following is a summary of the company's development work for the year ending August 31, 1927:
>
> *Development*
>
> | | Feet |
> |---|---|
> | Drifts and crosscuts | 7, 121 |
> | Raises | 2, 127 |
> | Dante | 1, 200 |
> | Diamond drilling | 2, 145 |
> | | 12, 593
(or 2⅖ miles) |
>
> A large number of machines have been used on development the past year. This work has been done on all levels of the mine. While resulting in the discovery of a number of small ore bodies, the ore opened on 19 and 20 is the most valuable to the mine.
>
> This development is still continuing.

The Dante mine has had a great deal of work done, with shipments amounting to $13,513.67 gross value, $8,715.34 net value, and 1,200 feet of new work. This work is now about completed. Any new work will be done from the Cresson workings.

There is about two years' ore developed and broken at present rate of shipment.

The water, while still of large volume, is easily taken care of by the present pumps, but adds materially to the cost of mining.

On July 26, 1927, we started retimbering the upper portion of the shaft; during August only 23 tons of ore were shipped; this reduced shipments for the year.

Total production, Cresson Consolidated Gold Mining & Milling Co., Colo., 1903 to December 31, 1927

Period	Dry short tons	Gross value	Freight and treatment	Net value	Average gross value per ton	Average net value per ton	Dividends
1903 to Aug. 31, 1926	1,436,071	$28,642,097.42	$8,141,898.76	$20,500,198.66	$19.94	$14.27	
Sept. 1, 1926, to Aug. 31, 1927	104,645	1,354,755.53	492,197.49	862,558.04	12.95	8.24	
1903 to Aug. 31, 1927	1,540,716	29,996,852.95	8,634,096.25	21,362,756.70	19.46	13.86	$11,637,072.50
1903 to Dec. 31, 1927	1,568,591	30,316,406.36					11,881,072.50

The Queen Exploration Co. began operations on the main shaft of the Queen (1,020 feet deep) on September 15, 1927, and during the remainder of the year completed 350 feet of drifts and 350 feet of raises and shipped 4,200 tons of ore.

Beacon Hill.—Shipments of ore were made from the C. K. & N. (Raaler Lode) dump, and from the El Paso and Gold Dollar mines. Lessees opened up 320 feet of drifts on the Gold Dollar. Dump ore was shipped from the Zoe.

Bull Hill.—Producing mines on Bull Hill were the Big Banta, Blue Bird dump, Dante, Dexter, Gold Pinnacle dump, Gold Sovereign, Orpha May, Rubie dump, Trail, and Wild Horse. The Dante mine was taken over by the Cresson company. The Big Banta in 1927 was one of the most promising properties of the United Gold Mines Co. and yielded 38,149 tons of ore. At the Dexter mine drifting, upraising, and crosscutting totaling 630 feet was done in 1927, and 954 tons of ore was extracted. The Stratton Lease ceased work on the American Eagles group on December 15, 1926, and in 1927 worked the Orpha May and Los Angeles, producing ore from both.

Between Altman and Goldfield.—Producing mines between Altman and Goldfield were the Acacia and Free Coinage (both operated by the Nuesta Ventura Mining Corporation, which sunk one of the shafts 65 feet and did 400 feet of drifting), Deadwood, Empire Lee dump, Findley dump, Pharmacist dump, Theresa, Victor dump, and Vindicator. In December a fire completely destroyed the Vindicator surface buildings and caused cessation of shipments; the plant will be rebuilt.

Battle Mountain.—Producing mines were the Granite, Portland-Independence-Last Dollar group, and Rose Nicol. Development work at the Granite totaled 1,558 feet, consisting of 110 feet of winzes, 54 feet of raises, 879 feet of drifts, and 515 feet of crosscuts.

The annual report of the Portland Gold Mining Co. for 1927 (dated February 20, 1928) says:

> The results of the mining operations of your company during the past year failed to come up to expectations.
>
> Two dividends of $60,000 each were paid during the early part of the year, but due to the large amount expended for development, particularly on the 3,100-foot level, the cash balance was reduced to $159,326.79, therefore your directors deemed it wise to discontinue further dividends until such time as there should be a material increase in the profits from mining and milling operations.
>
> The development work in the mine during most of the year proved disappointing. A full statement concerning it will be found in the mine manager's report. However, I am pleased to inform you that the development work carried on during the past few months gives promise of excellent results in the coming year.
>
> Herewith is submitted a report of the operation of the Portland, Independence, and Last Dollar mines for the year 1927.
>
> For two very good reasons we have been unable to fulfill the predictions of one year ago, these being the decided decrease in the value of company and lessees' ore and the large expense incurred in exploring the 3,100-foot level. The grade of the company ore dropped as soon as the broken ore on 2,900 was exhausted. This condition we have been unable to improve, consistently, until January of 1928.
>
> The results from the expenditure of many thousands of dollars on 3,100 were decidedly disappointing. We cut a pump station, installed pumps, and did 754½ feet of exploratory work at a cost of $32,545.18. This work was stopped September first, and the pumps dismantled. The flow of water can be appreciated when it is known that the entire 3,100 workings were filled to the 3,000-foot level in about forty hours after the withdrawal of the pumps.
>
> ### EXPLORATION WORK IN PORTLAND MINE
>
> *2,100-foot level.*—The "Strong" west crosscut was driven 205½ feet and connected by a 33½-foot raise with the lowest level of the Strong mine. Six hundred one feet of crosscutting was driven through the south end of the Rex claim. A basic dike was cut which we intend to follow north into the mineral area.
>
> *2,300-foot level.*—Six hundred ninety-one feet were driven on 2,300, which opened 80 feet of good ore over the 2,400 East No. 1 stope.
>
> *2,400-foot level.*—Twelve hundred twenty feet of work on this level opened about 200 feet of ore on the East No. 1 vein, south of the big stope on 2,600.
>
> *2,600-foot level.*—Real results were obtained in 2,600 and 2,700, but so late in the year that benefit was not felt until in January, 1928. Eight hundred fifty-eight feet of work on 2,600 opened 130 feet of good ore, of an average width of 9 feet. A skip pocket was cut and put in operation at a cost of about $1,000. This has made possible the handling of 250 cars of muck a day on this level.
>
> *2,700-foot level.*—Five hundred eighty feet of drifts and crosscuts on this level opened the downward continuation of the new ore from 2,600. This ore shoot is now 70 feet long, with a still greater length in sight. We also made the 2,700 East No. 1 North stope of broken ore available for tramming.
>
> *3,000-foot level.*—A raise from this level to 2,700 required 201½ feet of work. A fair tonnage of mill dirt will be mined through this raise from the bottom of the 2,700 South No. 1 Stope.
>
> *Production.*—The Portland mine produced 2,847 tons of company ore, 139,096 tons of mill dirt, and the lessees shipped 9,091 tons, making a total production of 151,034 tons. This represented 83 per cent of the 182,311 gross tons mined.
>
> *Water.*—We pumped 508,344,000 gallons of water from an average depth of 1,000 feet at a cost of $35,657.95. This cost was divided as follows: Labor, $9,939.27; power, $24,475.53; repairs, $1,243.15.
>
> *Equipment.*—The equipment is in good condition, and there will not need to be any heavy expenditure in 1928, except that possibly we may need to purchase one new flat hoisting rope.
>
> ### LAST DOLLAR MINE
>
> The company shipped 213 tons of reject and 2,715 tons of mill dirt. The lessees shipped 12,697 tons of ore, making a total production of 15,624 tons. Owing to the lack of lessees, the mine was closed September first. It was reopened on November first after an agreement had been reached with the

Stratton Lease whereby they were permitted to do work on 600 to open ore on the Los Angeles property. This revenue, combined with the royalty from a few sets of lessees, has put the Last Dollar on a paying basis. Five hundred seventy-one feet of exploratory work was done from the seventeenth level of the Portland mine, which is 250 feet below the bottom of the Last Dollar shaft.

INDEPENDENCE MINE

The Independence shaft was operated five months, closing June first. The grade of the ore was so low that expenses could not be made. We produced 22,464 gross tons at an expense of $8,023.44, making a cost per gross ton of 35.7 cents. Forty-seven per cent of the gross was put through the mill at a cost for mining of 76.2 cents. In order to make the waste cribbing safe it has been necessary to spend $654.63 since the shutdown.

The Portland Gold Mining Co. of Wyoming

OPERATION FOR THE YEAR 1927

Gross value of ore mined and shipped		$149, 301. 76
Gross value recovered by mill		660, 292. 68
		809, 594. 44
Net cost of mining and milling		1, 008, 782. 03
Loss from operation of mines and mill		199, 187. 59
Profit and loss for the year 1927:		
Loss from operations		199, 187. 59
Interest received	$6, 202. 24	
Discount and exchange	1, 043. 79	
Registration fees	60. 60	
		7, 306. 63
Loss before depreciation and depletion		191, 880. 96
Depreciation	$107, 783. 40	
Depletion	46, 928. 44	
		154, 711. 84
Final loss—to surplus		346, 592. 80
Surplus:		
Balance Jan. 1, 1927		1, 166, 400. 52
Loss for the year 1927	$346, 592. 80	
Dividends paid	120, 000. 00	
		466, 592. 80
Balance Jan. 1, 1928		699, 807. 72

CASH RECEIPTS AND DISBURSEMENTS

Balance Jan. 1, 1927		$498, 013. 81
Receipts:		
From operation of mine and mills	$739, 916. 43	
Royalties	44, 951. 53	
Bills and accounts receivable	13, 997. 35	
Interest on bank balances	6, 122. 79	
Registration fees	60. 60	
Unclaimed dividends	22. 00	
Redemption of tax sale certificate	22. 31	
Sales of stores and supplies and receipts from sundry sources	713. 63	
		805, 806. 64
		1, 303, 820. 45
Disbursements:		
Vouchers and pay checks	1, 024, 493. 66	
Dividends paid	120, 000. 00	
		1, 144, 493. 66
Balance Jan. 1, 1928		159, 326. 79

BALANCE SHEET, JANUARY 1, 1928

Assets:		
Cash		$159, 326. 79
Accounts receivable		1, 712. 30
Stores and supplies at mines and mill		51, 210. 94
Property—		
Mines	$4, 231, 769. 08	
Mill	1, 107, 704. 10	
		5, 339, 473. 18
Permanent equipment		651, 833. 19
Stocks, bonds, and securities		84, 939. 44
Prepaid expenses		11, 748. 25
		6, 300, 244. 09
Liabilities:		
Accounts payable		2, 338. 33
Reserve for depreciation and depletion		2, 598, 098. 04
Capital—		
Capital stock	$3, 000, 000. 00	
Surplus	699, 807. 72	
		3, 699, 807. 72
		6, 300, 244. 09

Statement of ore production of the Portland mine from April 1, 1894, to December 31, 1927

	Net tons	Gross value
Apr. 1 to Dec. 31, 1894	7, 826. 286	$553, 975. 75
Jan. 1 to Dec. 31, 1895	31, 516. 346	1, 700, 094. 89
1896	23, 598. 172	1, 116, 128. 29
1897	18, 852. 224	1, 177, 642. 65
1898	27, 798. 850	1, 879, 681. 96
1899	38, 548. 090	1, 951, 219. 34
1900	60, 786. 755	2, 351, 396. 26
1901	76, 905. 550	2, 408, 413. 23
1902	89, 664. 279	2, 334, 023. 76
1903	90, 244. 582	2, 608, 993. 59
1904	96, 521. 385	2, 598, 724. 84
1905	109, 233. 496	2, 422, 033. 42
1906	103, 614. 253	1, 932, 083. 22
1907	79, 960. 049	1, 600, 950. 52
1908	94, 311. 432	1, 834, 080. 79
1909	83, 908. 459	1, 438, 650. 35
1910	67, 515. 200	1, 241, 168. 30
1911	50, 258. 435	1, 140, 054. 05
1912	44, 562. 015	987, 415. 58
1913	53, 245. 500	1, 380, 712. 78
1914	62, 997. 538	1, 467, 004. 79
1915	72, 192. 361	1, 710, 276. 80
1916	96, 045. 513	2, 236, 842. 46
1917	86, 688. 060	1, 768, 971. 59
1918	53, 887. 181	1, 120, 851. 25
1919	45, 416. 640	1, 173, 615. 60
1920	31, 425. 778	867, 381. 08
1921	7, 806. 760	223, 666. 96
1922	27, 336. 645	576, 327. 76
1923	30, 346. 024	675, 218. 57
1924	21, 530. 966	656, 067. 70
1925	18, 149. 956	437, 999. 27
1926	27, 409. 429	647, 696. 69
1927	12, 779. 206	149, 301. 76
Total	1, 842, 883. 445	48, 368, 665. 85

Victor mills

	Net tons	Gross value
July 1 to Dec. 31, 1910	46, 237. 000	$113, 253. 44
Jan. 1 to Dec. 31, 1911	120, 961. 000	424, 489. 15
1912	173, 361. 000	547, 424. 00
1913	178, 162. 000	526, 186. 80
1914	210, 132. 000	539, 130. 97
1915	282, 192. 000	819, 432. 54
1916	322, 892. 000	803, 380. 89
1917	471, 873. 000	966, 764. 81

Victor mills—Continued

	Net tons	Gross value
Jan. 1 to Dec. 31, 1918	522, 756. 000	$1, 071, 924. 53
1919	327, 776. 000	645, 644. 50
1920	205, 498. 000	509, 997. 67
1921	208, 051. 000	1, 005, 293. 93
1922	163, 842. 000	497, 578. 14
1923	151, 082. 000	503, 363. 29
1924	165, 866. 000	781, 119. 29
1925	194, 902. 000	837, 165. 71
1926	181, 172. 000	925, 720. 28
1927	190, 775. 000	593, 298. 32
Total	4, 117, 530. 000	12, 111, 168. 26
Grand total of ore production to date	5, 960, 413. 445	60, 479, 834. 11

Total dividends paid to Jan. 1, 1928, $11,992,080.

Statement of all work in Portland mine to January 1, 1928

	Totals during 1927, in feet	Total previous years, in feet	Grand total, in feet
Drifts	2, 371. 5	165, 525. 5	167, 897. 0
Crosscuts	2, 539. 0	150, 249. 5	152, 788. 5
Raises	285. 5	33, 126. 5	33, 412. 0
Winzes		6, 876. 5	6, 876. 5
Shafts		13, 818. 5	13, 818. 5
	5, 196. 0	369, 596. 5	374, 792. 5

Total for Portland mine, 70 miles 5,192.5 feet.
Total (not included above) for Independence mine, 17 miles 1,917.5 feet.

Squaw Mountain.—The Granite Gold Mining Co. made a small production from the Nellie V and X–10–U–8 claims on Squaw Mountain. Several hundred tons of ore was shipped from the Santa Rita property.

United Gold Mines Co.—The annual report of the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district, in addition to reporting a production of 93,840 tons of ore in 1927, says:

> Beginning with the year 1927 the Rose Nicol and Big Banta were the most promising of the properties of the United Gold Mines Co. The development work has resulted in the discovery of further ore in both the above mines, but there is not as much developed ore as at the beginning of the year.
>
> In the Vindicator Mine ore of good size and value has been discovered on the eighth and tenth levels and also in the Golden Cycle mine immediately adjoining.
>
> On the Bonanza development work has shown a good body of ore, and while it is too early to state definitely of what value, a good profit should be realized from it.
>
> Development work is being carried on in other parts of the property, but the ore developed is only in small bodies.
>
> On the drainage-tunnel level a large amount of work has been done on the basalt dykes, and on a condition similar to that in which the Cresson ore was found. While we have shipped a large tonnage of low grade from the upper levels, the ore in the tunnel level was too low grade to mine.
>
> The condition of the company is much better than at the commencement of 1927.

Total production of property

	Net tons	Gross value
Ore mined before consolidation	26, 310	$456, 806. 19
Production under operations of the United Gold Mines Co	635, 795	8, 293, 720. 60
Total to Dec. 31, 1927	662, 105	8, 750, 526. 79

Operating statement, United Gold Mines Co., 1927

Receipts		Expenses	
Crusher No. 2	$1, 733. 57	Cripple Creek office expenses	$1, 209. 50
Royalties	45, 150. 78	Colorado Springs office expenses	57. 07
Miscellaneous earnings	10, 537. 06	Salaries	5, 100. 00
Rip rap	63. 30	Mine owners association	576. 00
Company ore sales	311, 880. 40	Fire insurance	60. 00
Interest	2, 978. 05	Taxes	2, 000. 00
Crushed rock sales	4, 425. 28	Federal taxes	14, 196. 53
		Miscellaneous expense	957. 20
		Compensation insurance officers	1. 20
		Fairview lease	1, 155. 54
		Trail	169, 535. 40
		Vindicator	62, 082. 55
		Rose Nicol	269. 86
		Bonanza	12, 968. 03
		Wrecking account	653. 20
		Gain from operations	105, 946. 36
	376, 768. 44		376, 768. 44

Profit and loss—Recapitulation—United Gold Mines Co., 1927

Vindicator storehouse	$526. 03	
Bonanza storehouse	691. 21	
Depreciation of mines, buildings, etc	1, 921. 38	
Depletion of mines, buildings, etc	50, 352. 35	
Dividends, 1927	48, 017. 39	
Bad debts	151. 04	
Gain from operations		$105, 946. 36
Fire insurance suspense		472. 18
Mine owners association		41. 00
Profit and loss balance Dec. 31, 1927	4, 800. 14	
	106, 459. 54	106, 459. 54

Production of the United Gold Mines Co. in 1927

Group	Net tons	Gross value	Royalties	Company ore	Lessees' ore	Average per ton
Axtel	363	$4, 745. 34	$391. 16		$2, 232. 52	$13. 06
Coriolanus	1, 031	4, 405. 71	183. 09		1, 430. 29	4. 28
Deadwood	4, 220	14, 830. 01	526. 38		2, 910. 24	3. 51
Hardwood	7	130. 57	10. 16		56. 30	19. 00
Ida May	24	83. 93	2. 26		19. 46	3. 50
Londonderry	84	863. 90	50. 80		141. 32	10. 31
New Market			791. 26			
Requa (Big Banta)	38, 149	454, 339. 78	2. 93	$302, 693. 17	17. 61	11. 91
Rose Nicol	570	8, 152. 24		4, 328. 78		14. 31
Theresa	4, 504	33, 678. 81	6, 355. 97			7. 48
Vindicator	41, 920	205, 104. 06	34, 084. 37	4, 858. 45	46, 085. 18	4. 89
Wildhorse	72	392. 25	14. 03		87. 44	5. 44
W. P. H	2, 896	38, 664. 41	2, 738. 37		18, 810. 37	13. 35
	93, 840	765, 391. 01	45, 150. 78	311, 880. 40	71, 790. 73	8. 1

Development of the United Gold Mines Co. in 1927

	Feet
Wildhorse group: Cain Leasing Co	113
Vindicator lessees	3, 465
Bonanza group	165
Vindicator Co	954
Requa group	4, 324
Rose Nicol	80
	9, 101

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By C. N. Gerry[1]

SUMMARY

The value of mine production of gold, silver, copper, lead, and zinc in Idaho decreased from $30,969,551 in 1926 to $28,104,413 in 1927. The decrease was due chiefly to the decline in the prices of lead and zinc, as the quantity of all metals increased. The total value of the metal output of Idaho in 1927, however, was more than the average annual value for the decade 1918 to 1927, which was $26,317,201. Since 1863 Idaho has yielded an output of the five metals, as follows: Gold, $136,214,642; silver, 298,614,646 fine ounces; copper, 147,057,516 pounds; lead, 8,211,665,893 pounds; and zinc, 615,151,024 pounds. The total value has amounted to $880,735,214, more than half of which is accounted for by lead. The value of the metal output of Idaho from the early days of mining is by no means as large as that of Arizona, California, Colorado, Montana, or Utah, but in 1927 Idaho was third in silver output after Utah and Montana and third in lead output after Missouri and Utah. Dividends for 1927, taken largely from the annual printed reports of the companies but partly estimated, amounted to $5,907,317. It is impossible to procure the exact total, as part of the dividend disbursement is paid from operations in other States, and the amount paid by certain lessees is not reported.

Although the metal output of Idaho in 1927 was derived from 23 counties, most of the silver, copper, lead, and zinc was recovered from ore and concentrates from Shoshone County, or the famous Coeur d'Alene region, whose metal output was valued at $26,091,273. Lemhi, Custer, Bonner, and Blaine Counties followed in order, but no one of them attained an output valued at as much as $700,000 in 1927.

Tables printed in Mineral Resources for 1922 and subsequent years give the source of the different metals by kinds of ore and by years from 1911 to 1927. During that period 86 per cent of the gold was derived from placers and from dry and siliceous ore; nearly 76 per cent of the silver and about 80 per cent of the lead came from lead ore, and most of the remainder of the silver and lead came from lead-zinc ore and zinc ore. In 1927, 81 per cent of the gold was derived from placers and from dry and siliceous ore; 63 per cent of

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[1] The valuable assistance of B. N. Lowry and Paul Luff, of the Bureau of Mines, is acknowledged.

the silver and 73 per cent of the lead came from lead ore and most of the remainder of the silver and lead came from lead-zinc ore and copper-lead ore.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1918–1927

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1918	216	85	2,091,619	33,998.72	$702,816	9,172,340	$9,172,340
1919	138	72	1,457,395	34,502.89	713,238	5,579,056	6,248,543
1920	114	49	1,958,401	23,490.42	485,590	7,326,794	7,986,205
1921	133	92	1,514,447	26,399.73	545,731	6,080,528	6,080,528
1922	154	94	1,436,884	24,255.46	501,405	6,081,865	6,081,865
1923	146	85	1,763,520	37,124.28	767,427	7,673,662	6,292,403
1924	141	79	1,711,988	26,921.80	556,523	7,793,154	5,221,413
1925	190	85	1,827,715	20,886.92	431,771	7,743,439	5,373,947
1926	177	69	1,934,143	13,669.27	282,569	7,556,444	4,715,221
1927	148	70	2,018,325	15,315.67	316,603	8,901,409	5,047,099

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	6,533,888	$1,613,870	294,695,993	$20,923,416	45,161,712	$4,109,716	$36,522,158
1919	3,122,763	580,834	182,341,898	9,664,121	15,994,229	1,167,579	18,374,315
1920	2,538,396	467,065	249,609,976	19,968,798	27,932,326	2,262,518	31,170,176
1921	1,688,195	217,777	198,469,119	8,931,110	33,463	1,673	15,776,819
1922	3,282,842	443,184	195,834,205	10,770,881	4,109,131	234,220	18,031,555
1923	3,979,631	585,006	242,355,733	16,964,901	27,952,749	1,900,787	26,510,524
1924	2,738,824	358,786	248,950,292	19,916,023	15,340,498	997,132	27,049,877
1925	3,297,443	468,237	253,041,790	22,014,636	31,237,240	2,374,030	30,662,621
1926	1,337,442	187,242	272,980,212	21,838,417	52,614,691	3,946,102	30,969,551
1927	2,173,163	284,684	302,038,423	19,028,421	53,556,345	3,427,606	28,104,413

Gold and silver produced at placer mines in Idaho, 1918–1927

Year	Gold		Silver		Year	Gold		Silve	
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value	Fine ounces	Valu
1918	13, 371. 33	$276, 410	3, 283	$3, 283	1923	24, 125. 05	$498, 709	6, 616	$5, 42
1919	9, 227. 63	190, 752	1, 902	2, 130	1924	17, 324. 10	358, 121	4, 248	2, 84
1920	5, 505. 76	113, 814	1, 119	1, 219	1925	12, 692. 92	262, 386	2, 812	1, 952
1921	8, 784. 90	181, 600	1, 686	1, 686	1926	8, 360. 45	172, 826	2, 029	1, 266
1922	8, 899. 64	183, 972	1, 959	1, 959	1927	7, 520. 33	155, 459	2, 306	1, 308

GOLD

The mine production of gold in Idaho in 1927 was $316,603, an increase of 12 per cent over 1926 but much less than the average annual output ($530,367) for the decade 1918 to 1927. The gold output from Idaho was decreasing steadily before 1920, but dredges in Elmore and Shoshone Counties brought up the output in 1923. In 1927 gold from lode mines increased, but that from placer mines decreased, especially from placers worked by dredges. Lode mines yielded $161,144 in gold in 1927; placers yielded $155,459, of which $114,116 was won by dredges, a decrease of $27,044 from the dredge output in 1926. Since 1897 gold worth $5,893,514 has been recovered by dredges. Gold from gold ore increased materially in 1927, and increases were also recorded from copper ore and lead ore. The production of gold from mills using amalgamation was 3,791.30 ounces, 25 per cent of the total gold output in 1927 and an increase from 2,030.09 ounces in 1926. Concentrates of all kinds yielded nearly 19 per cent of the total gold, crude ore shipped for smelting yielded 7 per cent, and placers yielded 49 per cent.

In 1927 only three mines had a gold output of more than $30,000 each—those of the South Park Dredging Co. at Featherville, the Idawa Gold Mining Co. at Placerville, and the Gold Dredging & Power Corporation at Centerville. Other large producers of gold were the Idaho Metals Co. at Mackay, the Boise Placer Co. at Idaho City, and the Lincoln mine at Pearl. The dredge of the Yukon Gold Co. at Murray, the largest producer of gold in Idaho in 1925 and the second largest producer in 1926, ceased operations and dismantled the dredge in May, 1926.

SILVER

The mine production of silver in Idaho in 1927 increased 18 per cent in quantity and was decidedly more than the yearly average for the decade 1918 to 1927, which was about 7,390,900 ounces. Compared with other large producing States Idaho produced more silver than Arizona or Nevada but less than Utah or Montana. The output of silver in Shoshone County increased 1,304,052 ounces, and there were also good increases in Lemhi, Butte, and Blaine Counties, but the output from Boundary, Bonner, and Custer Counties was much smaller. The increase in silver was due largely to the decided increase in shipments of copper-lead concentrate rich in silver from the Sunshine mine in Shoshone County; the Federal Mining & Smelting, the Hecla, and the Bunker Hill & Sullivan companies also made good increases in silver output.

Concentrates yielded nearly 84 per cent of the total silver, crude smelting ore 16 per cent, and placer bullion and gold and silver bullion from lode mines less than one-tenth of 1 per cent.

The Morning mine of the Federal Mining & Smelting Co. was the largest producer of silver, followed closely by the Hecla and the Bunker Hill & Sullivan properties; each of these properties yielded more than 1,500,000 ounces of silver. The Sunshine Mining Co. more than doubled its output of silver in 1927 and was the fourth largest producer in Idaho. Other large producers of silver were the Tamarack & Custer, Gold Hunter, Callahan Zinc-Lead (Galena), United Idaho (Pittsburg-Idaho), Strattons, and Page mines.

COPPER

The mine production of copper in Idaho in 1927 increased 62 per cent in quantity over 1926 as a result of the increased output of the Idaho Metals Co. at Mackay, Custer County, and the Sunshine Mining Co. in Shoshone County. The output in 1927 was 2,173,163 pounds, or nearly 1,000,000 pounds less than the average yearly output (about 3,069,300 pounds) for the decade 1918 to 1927. The production of copper in Custer County increased from 262,769 pounds in 1926 to 696,830 pounds in 1927 and that in Shoshone County from 962,447 to 1,306,773 pounds. Concentrates of all kinds yielded 86 per cent of the total copper and crude smelting ore 14 per cent.

The largest producers of copper in the State in 1927 were the Idaho Metals Co. at Mackay, Custer County, and the Hecla, Sunshine, Snow Storm, and Bunker Hill & Sullivan mines in Shoshone County.

LEAD

The mine production of lead in Idaho in 1927 was the largest since 1917. The quantity increased nearly 11 per cent over 1926; the total value, however, decreased $2,809,996, as the average price of lead declined from 8 cents a pound in 1926 to 6.3 cents in 1927.

The general increase in lead output was due chiefly to activity at the Bunker Hill & Sullivan, Page, and Galena mines. Shoshone County supplied 94 per cent of the total lead, and Lemhi, Custer, Butte, Bonner, and Blaine Counties also made good production. Concentrates of all kinds yielded 84 per cent of the total lead and crude smelting ore 16 per cent.

Twelve mines produced more than 3,000,000 pounds of lead each in 1927. Three of them—the Bunker Hill & Sullivan, Morning, and Hecla—yielded more than 57,000,000 pounds each; the other large producers were the Tamarack & Custer, Gold Hunter, Page, United Idaho, Galena (Callahan Zinc-Lead Co.), Sidney, Strattons, Star (Sullivan Mining Co.), and Livingston mines.

ZINC

The mine production of zinc in Idaho in 1927 amounted to 53,556,345 pounds, the largest output since 1917 and an increase of nearly 2 per cent over the large output of 1926. The gain was due to the great increase in lead-zinc ore mined at the Morning and Sidney mines. All the zinc concentrates, except those from Blaine, Camas, and Custer Counties, came from the Coeur d'Alene region, where the largest producers of zinc were the Morning, Sidney, Constitution, Star, Frisco, Highland-Surprise, and Page mines. The Triumph mine, in Blaine County near Hailey, was also a large producer of zinc. Ore that was not milled locally was shipped to custom milling plants at Butte and Anaconda, Mont., and Bauer, Utah. The resulting zinc products were treated at the electrolytic zinc plant near Great Falls, Mont., or were shipped to Portland, Oreg., for export.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1927, by counties

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Ada	80.59	$1,666	1.55	$32	$1,698	37	$21
Adams	.24	5			5	57	32
Bear Lake						40	23
Blaine	68.11	1,408			1,408	83,392	47,283
Boise	4,599.50	95,080	2,765.55	57,169	152,249	18,264	10,356
Bonner	2.95	61			61	120,594	68,377
Bonneville			19.54	404	404		
Boundary						17,409	9,871
Butte	6.63	137			137	43,493	21,661
Camas	1.02	21			21	984	558
Canyon			2.08	43	43		
Clearwater			60.08	1,242	1,242	9	5
Custer	850.33	17,578	96.32	1,991	19,569	134,170	76,074
Elmore	28.73	594	3,859.41	79,781	80,375	1,256	712
Gem	639.76	13,225			13,225	11,380	6,452
Idaho	273.76	5,659	393.77	8,140	13,799	245	139
Latah			16.83	348	348	1	1
Lemhi	554.23	11,457	142.32	2,942	14,399	207,522	117,665
Owyhee	233.22	4,821	5.90	122	4,943	6,132	3,477
Shoshone	364.21	7,529	51.62	1,067	8,596	8,256,126	4,681,223
Twin Falls			7.64	158	158		
Valley	92.01	1,902	95.88	1,982	3,884	112	64
Washington	.05	1	1.84	38	39	186	105
	7,795.34	161,144	7,520.33	155,459	316,603	8,901,409	5,047,099
Total, 1926	5,308.82	109,743	8,360.45	172,826	282,569	7,556,444	4,715,221

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada	19	$3	257	$16			$1,738
Adams	3,370	441					478
Bear Lake			29,624	1,866			1,889
Blaine	3,116	408	1,105,907	69,672	1,274,467	$81,566	200,337
Boise	3,969	520	135,626	8,545			171,670
Bonner	3,142	412	2,099,817	132,289			201,139
Bonneville							404
Boundary			935,053	58,908			68,779
Butte	1,359	178	2,363,805	148,920			173,896
Camas	86	11	1,156	73	1,527	98	761
Canyon							43
Clearwater							1,247
Custer	696,830	91,285	3,415,556	215,180	18,163	1,162	403,270
Elmore							81,087
Gem	1,855	243	42,400	2,671			22,591
Idaho							13,938
Latah							349
Lemhi	152,156	19,932	7,987,520	503,214			655,210
Owyhee	79	10	1,716	108			8,538
Shoshone	1,306,773	171,187	283,896,615	17,885,487	52,262,188	3,344,780	26,091,273
Twin Falls							158
Valley							3,948
Washington	409	54	23,371	1,472			1,670
	2,173,163	284,684	302,038,423	19,028,421	53,556,345	3,427,606	28,104,413
Total, 1926	1,337,442	187,242	272,980,212	21,838,417	52,614,691	3,946,102	30,969,551

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Idaho, 1926–27, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1926	1927	1926	1927	1926	1927
Ada	1	172	1	3	$13.00	$9.81
Adams		11		1		3.36
Bear Lake	1	20	1	1	1.00	1.15
Blaine	981	5,466	20	11	42.55	8.91
Boise	5,559	6,662	12	16	8.94	15.76
Bonner	3,868	3,557	7	7	23.97	19.24
Bonneville	2		1		14.50	
Boundary	23,572	7,920	1	1	1.55	1.25
Butte	1,781	7,908	8	2	2.46	3.14
Camas	15	14	1	1	27.13	41.36
Cassia	43		2		18.53	
Clark	130		1		.95	
Custer	21,539	45,298	10	9	4.55	2.07
Elmore	183	55	8	5	16.58	10.95
Gem	1	3,400	1	1	32.00	5.79
Idaho	342	650	5	9	12.95	8.86
Kootenai	3		1		2.33	
Lemhi	24,153	17,056	21	16	4.56	7.57
Owyhee	621	344	13	11	20.24	23.99
Shoshone	1,850,519	1,919,309	58	49	2.36	2.44
Valley	827	458	4	3	7.57	4.22
Washington	2	25	1	2	14.00	4.24
	1,934,143	2,018,325	177	148	2.49	2.58

Production of placer mines in Idaho in 1927, by counties

County	Mines[1]		Gold	Silver (fine ounces)	Total value
	Dredge	Hydraulic and sluicing			
Ada		1	$32		$32
Boise	2	16	57,169	813	57,630
Bonneville		2	404		404
Canyon		1	43		43
Clearwater		4	1,242	9	1,247
Custer		3	1,991	23	2,004
Elmore	1	4	79,781	1,242	80,485
Idaho		15	8,140	69	8,179
Latah		2	348	1	349
Lemhi		8	2,942	11	2,948
Owyhee		1	122	77	166
Shoshone		5	1,067	4	1,069
Twin Falls		2	158		158
Valley		2	1,982	57	2,015
Washington		1	38		38
	3	67	155,459	2,306	156,767
Total, 1926	3	62	[2] 172,826	[2] 2,029	[2] 174,092

[1] Also 4 drift mines in 1926.

[2] Includes output from 4 drift mines.

MINING INDUSTRY

Despite the fact that the average prices of silver, copper, lead, and zinc in 1927 were less than those in 1926, the general conditions for mining in Idaho were excellent, as shown by the increase in the quantity of each of the five metals—gold, silver, copper, lead, and zinc. Idaho retained its position as a large producer of silver and lead. An important feature of the year, aside from the development of the smaller producing mines, was the mining of rich ore from the Sunshine mine which resulted in a production of more than 1,000,000 ounces of silver. Improvements in milling plants and the construction of a new electrolytic plant near Kellogg, Shoshone County, were of unusual interest.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Idaho, 1918–1927, with content in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
DRY AND SILICEOUS ORE						
1918	46, 315	11, 253. 45	69, 936	3, 703	8, 470	----
1919	48, 251	22, 262. 08	78, 531	11, 976	6, 455	----
1920	39, 811	13, 806. 37	91, 752	50, 437	17, 540	----
1921	48, 221	13, 826. 54	49, 034	7, 084	16, 942	----
1922	25, 766	9, 084. 91	91, 377	19, 252	25, 995	----
1923	24, 059	6, 570. 14	67, 294	5, 535	29, 719	----
1924	19, 260	5, 808. 43	47, 137	1, 159	3, 086	----
1925	18, 135	4, 054. 53	124, 911	51, 041	235, 762	----
1926	5, 862	2, 995. 17	24, 335	3, 852	7, 495	----
1927	5, 268	4, 823. 28	23, 420	3, 192	7, 992	----
COPPER ORE						
1918	127, 898	3, 339. 71	262, 991	5, 389, 887	----	----
1919	51, 546	962. 13	246, 983	2, 545, 044	----	----
1920	19, 259	1, 418. 69	52, 029	1, 738, 541	420	----
1921	10, 322	1, 258. 62	23, 987	1, 105, 511	----	----
1922	32, 590	2, 045. 78	41, 550	2, 572, 335	707	----
1923	41, 901	1, 516. 80	74, 247	2, 794, 091	3, 517	----
1924	37, 634	2, 407. 47	504, 644	1, 989, 050	131, 204	----
1925	51, 004	2, 785. 20	711, 874	2, 738, 861	33, 678	----
1926	28, 258	431. 64	429, 343	586, 387	42, 512	----
1927	27, 742	794. 38	49, 623	1, 030, 348	7, 000	----
LEAD ORE						
1918	1, 420, 878	2, 782. 34	8, 036, 861	1, 124, 503	262, 892, 200	----
1919	1, 149, 951	1, 970. 50	4, 757, 259	564, 415	160, 572, 291	----
1920	1, 480, 177	2, 497. 21	6, 091, 408	657, 627	210, 039, 183	----
1921	1, 446, 710	2, 467. 70	5, 688, 577	449, 883	198, 322, 374	----
1922	1, 331, 785	2, 590. 10	5, 450, 038	399, 160	193, 551, 305	1, 699, 261
1923	1, 192, 412	2, 066. 00	5, 489, 477	594, 748	191, 685, 757	----
1924	1, 254, 212	1, 061. 00	5, 815, 764	672, 154	201, 074, 111	151, 453
1925	1, 088, 564	1, 048. 63	4, 791, 497	272, 978	175, 631, 005	----
1926	1, 084, 345	1, 455. 74	4, 575, 490	430, 937	183, 074, 616	----
1927	1, 308, 987	1, 828. 47	5, 609, 605	735, 175	220, 178, 217	235, 768
COPPER-LEAD ORE						
1918	105	----	1, 706	11, 126	10, 151	----
1919	19	0. 58	192	1, 328	5, 604	----
1920	5, 015	95. 83	225, 181	69, 791	225, 308	----
1921	9, 122	61. 97	317, 244	125, 717	129, 803	----
1922	26, 143	1, 635. 00	459, 529	292, 095	333, 045	----
1923	52, 291	2, 587. 09	917, 215	546, 343	1, 167, 818	----
1924	3, 962	12. 21	140, 423	53, 387	536, 356	----
1925	6, 275	26. 31	230, 584	90, 477	1, 233, 092	----
1926	22, 037	33. 98	445, 520	116, 124	717, 352	----
1927	40, 125	1. 12	1, 079, 747	264, 399	1, 316, 757	----

Ore, old tailings, etc., sold or treated in Idaho, 1918–1927, with content in terms of recovered metals—Continued

ZINC ORE, COPPER-ZINC ORE, AND LEAD-ZINC ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	496, 423	251. 89	797, 563	4, 669	31, 785, 172	45, 161, 712
1919	207, 628	79. 97	493, 889		21, 757, 548	15, 994, 229
1920	414, 139	166. 56	865, 305	22, 000	39, 327, 525	27, 932, 326
1921	72					33, 463
1922	20, 600		34, 412		1, 923, 153	2, 409, 870
1923	452, 827	259. 20	1, 118, 813	38, 914	49, 468, 922	27, 952, 749
1924	396, 920	308. 59	1, 280, 938	23, 074	47, 205, 535	15, 189, 045
1925	663, 737	279. 33	1, 881, 761	144, 086	75, 908, 253	31, 237, 240
1926	793, 641	392. 29	2, 079, 727	200, 142	89, 138, 237	52, 614, 691
1927	636, 203	348. 09	2, 136, 708	140, 049	80, 528, 457	53, 320, 577

Ore, old tailings, etc., sold or treated in Idaho in 1927, with content in terms of recovered metals

Source	Mines producing	Ore and old tailings		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	41	[1] 4, 389	0. 22	4, 622. 17	30. 18	10, 584	0. 12
Dry gold and silver ore	5	37		141. 57	. 92	4, 324	. 05
Dry silver ore	7	842	. 04	59. 54	. 39	8, 512	. 09
Copper ore	9	27, 742	1. 37	794. 38	5. 19	49, 623	. 56
Lead ore	68	[2] 1, 308, 987	64. 86	1, 828. 47	11. 94	5, 609, 605	63. 02
Copper-lead ore	3	40, 125	1. 99	1. 12	. 01	1, 079, 747	12. 13
Lead-zinc ore	27	[3] 636, 203	31. 52	348. 09	2. 27	2, 136, 708	24. 00
Total, lode mines	[4] 148	2, 018, 325	100. 00	7, 795. 34	50. 90	8, 899, 103	99. 97
Total, placers	70			7, 520. 33	49. 10	2, 306	. 03
	218	2, 018, 325	100. 00	15, 315. 67	100. 00	8, 901, 409	100. 00
Total, 1926	246	1, 934, 143		13, 669. 27		7, 556, 444	

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	2, 378	0. 11	2, 940			
Dry gold and silver ore	166	. 01	1, 695			
Dry silver ore	648	. 03	3, 357			
Copper ore	1, 030, 348	47. 41	7, 000			
Lead ore	735, 175	33. 83	220, 178, 217	72. 90	235, 768	0. 44
Copper-lead ore	264, 399	12. 17	1, 316, 757	. 44		
Lead-zinc ore	140, 049	6. 44	80, 528, 457	26. 66	53, 320, 577	99. 56
	2, 173, 163	100. 00	302, 038, 423	100. 00	53, 556, 345	100. 00
Total, 1926	1, 337, 442		272, 980, 212		52, 614, 691	

[1] Includes 30 tons of old tailings amalgamated.

[2] Includes 171,941 tons of old tailings concentrated.

[3] Includes 878 tons of old tailings concentrated.

[4] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

Value of metals from ore and old tailings sold or treated in Idaho in 1927, by kinds of ore

Kind of ore	Ore and old tailings (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	4,389	$95,549	$6,001	$311	$185		$102,046
Dry gold and silver ore	37	2,926	2,452	22	107		5,507
Dry silver ore	842	1,231	4,826	85	211		6,353
Copper ore	27,742	16,421	28,136	134,976	441		179,974
Lead ore	1,308,987	37,798	3,180,646	96,308	13,871,228	$15,089	17,201,069
Copper-lead ore	40,125	23	612,217	34,636	82,956		729,832
Lead-zinc ore	636,203	7,196	1,211,513	18,346	5,073,293	3,412,517	9,722,865
	2,018,325	161,144	5,045,791	284,684	19,028,421	3,427,606	27,947,646
Total, 1926	1,934,143	109,743	4,713,955	187,242	21,838,417	3,946,102	30,795,459

GOLD ORE

Most of the gold ore in 1927—68 per cent—was produced from 11 mines in the Boise Basin district, Boise County; more than half of it came from the Belshazzar property, near Placerville, operated by the Idawa Gold Mining Co. The Unity Mines Co. and the Sunnyside Mining & Milling Co. each produced several hundred tons of gold ore. The yield from ore and a small quantity of old tailings was $21.77 in gold and 2.41 ounces of silver to the ton and a small quantity of copper and lead.

GOLD AND SILVER ORE

Four mines in Owyhee County and one property in Boise County shipped the 37 tons of gold and silver ore; most of the ore came from the mine near Centerville, in Boise County. The ore yielded $79.08 in gold and 116.86 ounces of silver to the ton as well as 2.29 per cent of lead and a small quantity of copper.

SILVER ORE

Small lots of silver ore were mined in 1927 at Hailey, Idaho City, and Clark Fork, but most of it came from two properties, one near Lakeview, in Bonner County, and the other near Silver City, in Owyhee County. The silver ore of the State as a whole yielded $1.46 in gold and 10.11 ounces of silver to the ton as well as a small quantity of lead and copper.

COPPER ORE

Copper ore was mined chiefly in Custer, Shoshone, and Lemhi Counties, and most of it—26,562 tons—was concentrated. The output of copper ore from Custer and Lemhi Counties increased materially in 1927, but there was a notable decrease in the quantity mined in Shoshone and Bonner Counties. Considerably more copper ore was mined in 1927 than in 1926 from the property of the

Idaho Metals Co. in Custer County, and this property was the largest producer of copper ore in Idaho; the Snow Storm mine in Shoshone County was the second largest producer. The output of the Crescent mine in Shoshone County was much less than that of 1926, and the Talache property in Bonner County, formerly a large producer of copper ore, was idle in 1927. The average recovered content of the copper ore shipped or treated in 1927 was 59 cents in gold and 1.79 ounces of silver to the ton, 1.86 per cent of copper, and a little lead.

LEAD ORE

Lead ore has been the most valuable mine product of Idaho since the Coeur d'Alene region became productive. The total output in 1927 was 21 per cent greater than that in 1926, and 77 per cent of it was ore of concentrating grade from Shoshone County; operators in Custer, Lemhi, Boundary, and Butte Counties also mined and shipped much lead ore. The Bunker Hill & Sullivan property at Kellogg in Shoshone County was the leading producer of lead ore, followed by the Hecla mine at Burke and the Gold Hunter mine at Mullan, both also in Shoshone County. The Livingston mine in Custer County led the mines in the other counties. Two mines in Idaho produced from lead ore alone nearly 50 per cent of the State's total lead in 1927. The average recovered content of the lead ore and old tailings in 1927 was 4.29 ounces of silver to the ton, 0.03 per cent of copper, 8.41 per cent of lead, and a little zinc.

COPPER-LEAD ORE

The output of copper-lead ore increased 18,088 tons, or 82 per cent, in 1927, chiefly owing to the fact that the Sunshine (Yankee Boy) property produced nearly twice as much copper-lead ore in 1927 as it did in 1926. The ore in the vicinity of Big Creek consists of galena and tetrahedrite, and as the latter increases the silver and copper are correspondingly increased. Nearly all the copper-lead ore in 1927 was concentrated and most of it came from Shoshone County; the total output yielded 26.91 ounces of silver to the ton, 0.33 per cent of copper, and 1.64 per cent of lead.

LEAD-ZINC ORE

No zinc ore was sold in 1927. The output of lead-zinc ore in 1927 decreased 20 per cent, and nearly all of it was concentrated. The Morning mine in Shoshone County produced more than half the total; other large producers were the Page, Sidney, Star, Constitution, Frisco, and Blackhawk mines, all in Shoshone County. The lead-zinc ore and old tailings yielded 3.36 ounces of silver to the ton, 0.01 per cent of copper, 6.33 per cent of lead, and 4.19 per cent of zinc.

Ore and old tailings sold or treated in Idaho in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	146	74.10	28	19		
Boise	3,006	3,970.65	9,193	2,315	1,224	
Elmore	55	28.75	14			
Idaho	650	273.76	176			
Lemhi	[1] 37	19.61	8			
Owyhee	37	163.29	1,110	44	1,716	
Valley	458	92.01	55			
	4,389	4,622.17	10,584	2,378	2,940	
Total, 1926	5,124	2,811.27	4,870	2,364	4,185	

DRY SILVER ORE

Blaine	3	1.57	229	22		
Boise	23	.35	300			
Bonner	513	2.74	3,764	591	3,357	
Owyhee	303	54.88	4,219	35		
	842	59.54	8,512	648	3,357	
Total, 1926	694	76.05	15,772	1,488	3,310	

COPPER ORE

Adams	11	0.22	57	3,370		
Bonner	10		35	2,342		
Custer	13,627	761.22	9,734	681,154		
Lemhi	2,764	25.94	276	94,187		
Shoshone	11,330	7.00	39,521	246,295	7,000	
	27,742	794.38	49,623	1,030,348	7,000	
Total, 1926	28,258	431.64	429,343	586,387	42,512	

LEAD ORE

Ada	26	6.49	9		257	
Bear Lake	20		40		29,624	
Blaine	526	38.56	41,796	3,072	364,958	
Boise	3,600	501.99	4,360	1,488	132,707	
Bonner	3,034	.20	116,795	209	2,096,460	
Boundary	7,920		17,409		935,053	
Butte	7,908	6.63	43,493	1,359	2,363,805	
Custer	31,449	87.81	94,647	4,077	3,328,073	
Gem	3,400	639.77	11,380	1,855	42,400	
Lemhi	14,255	508.69	207,227	57,969	7,987,520	
Shoshone	[2] 1,236,827	38.33	5,072,304	665,146	202,874,858	235,768
Washington	22		145		22,502	
	1,308,987	1,828.47	5,609,605	735,175	220,178,217	235,768
Total, 1926	1,084,345	1,455.74	4,575,490	430,937	183,074,616	

COPPER-LEAD ORE

Custer	122	1.09	29,199	8,308	67,458	
Shoshone	40,000		1,050,507	255,682	1,248,430	
Washington	3	.03	41	409	869	
	40,125	1.12	1,079,747	264,399	1,316,757	
Total, 1926	22,037	33.98	445,520	116,124	717,352	

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[1] Includes 30 tons of old tailings amalgamated.

[2] Includes 171,941 tons of old tailings concentrated.

Ore and old tailings sold or treated in Idaho in 1927, by counties, with content in terms of recovered metals—Continued

LEAD-ZINC ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	4, 937	28. 00	41, 367	22	740, 949	1, 274, 467
Camas	14	1. 03	984	86	1, 156	1, 527
Custer	100	. 21	567	291	20, 025	18, 163
Shoshone	[3] 631, 152	318. 85	2, 093, 790	139, 650	79, 766, 327	52, 026, 420
	636, 203	348. 09	2, 136, 708	140, 049	80, 528, 457	53, 320, 577
Total, 1926	793, 641	392. 29	2, 079, 727	200, 142	89, 138, 237	52, 614, 69

[3] Includes 878 tons of old tailings concentrated.

Lead-zinc ore and zinc and lead-zinc concentrates (as marketed from Idaho mines and mills) sold to smelters in 1927

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Sulphide lead-zinc ore	Shoshone	52	18, 192	17. 49	15, 100
Zinc and lead-zinc concentrates.	Blaine, Camas, Custer, and Shoshone.	63, 596	62, 209, 883	48. 91	53, 541, 245
		63, 648	62, 228, 075	48. 88	53, 556, 345

METALLURGIC INDUSTRY

In the past much of the ore mined in Idaho was treated by amalgamation or cyanidation, but in 1927 comparatively little ore was treated by these methods. The general tendency seems to be toward concentrating and smelting. More than 85 per cent of the total value of the metal output of the State in 1927 was from concentrates, and most of the remainder was from crude smelting ore. Marked progress was made in metallurgy, especially in the treatment of lead-zinc ore by flotation, and several new mills were under construction and others were adding flotation equipment or being changed to regular flotation plants; work at the Morning, Sweeny, Page, Constitution, Galena, Hecla, Jack Waite, and Lincoln plants was noteworthy. The agreements made with a Belgian smelting company, whereby the marketing of zinc concentrate has been facilitated, expired in 1927. Construction of the Sullivan Mining Co.'s electrolytic zinc reduction plant at Silver King, near the Bunker Hill smelter, was vigorously pushed throughout the year, and the plant should be in operation late in 1928.

In Idaho 57 milling plants of all kinds were active in 1927, the same number as in 1926. Of these mills 35 were concentration plants, 15 of which used flotation machines with other concentrating devices, 13 used flotation alone, and 7 used crushers, jigs, and tables, without flotation cells; 19 used amalgamation alone; 2 used amalgamation with concentration tables; and 1 used cyanidation with concentrating tables.

A list of the ore-milling plants, with their general features, in Idaho in 1925, prepared by the Bureau of Mines, may be had upon request.

In 1927 less than one-half of 1 per cent of the total ore and old tailings, or 4,323 tons of ore and 30 tons of old tailings, was treated in gold and silver mills; the gold and silver recovered were valued at $79,368, or $18.23 per ton of material treated. The companies purchased 335 pounds of quicksilver in 1927, an average of 0.0779 pound per ton of ore and old tailings amalgamated and 0.0632 pound per ounce of gold and silver bullion saved.

Of the total ore and old tailings 96 per cent was concentrated. Metals recovered from the concentrates—from ore concentrated, from 172,819 tons of old tailings re-treated, and from part of the ore treated in gold and silver mills—were valued at $76.53 to the ton of concentrates compared with $88.15 in 1926. The concentrates came largely from the Coeur d'Alene region, where the ratio was 6.18 tons of ore and old tailings to 1 ton of concentrate. The large increase in lead concentrate more than offset the decreases in zinc concentrate and lead-zinc concentrate. Operators in Shoshone County shipped an average of 25,135 tons of concentrates of various kinds a month, compared with 23,818 tons in 1926. This amount, with the crude ore shipped to smelters (4,549 tons a month), gives the Coeur d'Alene region an average monthly output of 29,684 tons of concentrates and crude ore, compared with 28,703 tons in 1926. The average value of metals recovered from lead concentrates declined from $91.59 to the ton of concentrates in 1926 to $78.03 in 1927, that from zinc concentrate from $68.24 to $61, and that from lead-zinc concentrate from $80.11 to $65.98. The average value of the copper-lead concentrate increased considerably, as the concentrate contained much silver, but the average value of the copper concentrate decreased.

Of the total ore 4 per cent was shipped crude to smelters at Bradley, Idaho; East Helena and Anaconda, Mont.; Tacoma, Wash.; and plants near Salt Lake City, Utah. The total value of the metals recovered from first-class ore was $3,911,420, as compared with $4,879,793 in 1926. Of the crude ore shipped to smelters 98 per cent was lead ore; the remainder was largely copper ore. Most of the ore smelted was sulphide, although 21 per cent of the lead ore was carbonate.

The combined value of the metals from concentrates and crude shipping ore was $27,868,278 in 1927, compared with $30,751,277 in 1926.

No material, other than ore and old tailings milled or smelted, was treated in 1927, and no ore was treated locally by either leaching or roasting methods.

Mine production of metals from gold and silver mills in Idaho in 1927, by counties

County	Ore and old tailings treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Ada	132		68. 34	24		
Boise	3, 007		3, 276. 34	995	0. 20	210
Elmore	55		28. 75	14		
Idaho	650		273. 76	176		
Lemhi	7	30	19. 61	8		
Owyhee	14		32. 49	236		
Valley	458		92. 01	55		
	4, 323	30	3, 791. 30	1, 508	0. 20	240
Total, 1926	4, 499	45	2, 030. 09	925		

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Boise	476	640. 91	7, 646	2, 315	1, 224
	476	640. 91	7, 646	2, 315	1, 224
Total, 1926	125	255. 99	3, 136	600	309

Mine production of metals from concentrating mills in Idaho in 1927, by counties

County	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	26		2	6. 49	9		257	
Blaine	4, 937		2, 176	28. 00	41, 367	22	740, 949	1, 274, 467
Boise	3, 600		240	501. 99	4, 360	1, 488	132, 707	
Bonner	872		128	2. 16	4, 655	288	127, 889	
Boundary	7, 920		792		17, 409		935, 053	
Butte	7, 901		2, 177	3. 77	43, 112	1, 272	2, 363, 033	
Camas	14		4	1. 03	984	86	1, 156	1, 527
Custer	43, 793		4, 916	643. 17	98, 153	583, 161	3, 192, 999	18, 163
Gem	3, 400		290	639. 77	11, 380	1, 855	42, 400	
Lemhi	2, 724		224	2. 52	143	84, 524		
Owyhee	302		3	44. 38	3, 561	35		
Shoshone	1, 691, 902	172, 819	301, 619	346. 41	7, 226, 945	1, 187, 572	246, 389, 593	52, 247, 088
	1, 767, 391	172, 819	312, 571	2, 219. 69	7, 452, 078	1, 860, 303	253, 926, 036	53, 541, 245
Total, 1926	1, 820, 876	33, 373	293, 374	1, 952. 35	6, 134, 544	1, 042, 607	223, 825, 422	52, 584, 197

Mine production of metals from Idaho concentrates in 1927

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	2	6.49	9		257	
Blaine	2,176	28.00	41,367	22	740,949	1,274,467
Boise	716	1,142.90	12,006	3,803	133,931	
Bonner	128	2.16	4,655	288	127,889	
Boundary	792		17,409		935,053	
Butte	2,177	3.77	43,112	1,272	2,363,033	
Camas	4	1.03	984	86	1,156	1,527
Custer	4,916	643.17	98,153	583,161	3,192,999	18,163
Gem	290	639.77	11,380	1,855	42,400	
Lemhi	224	2.52	143	84,524		
Owyhee	3	44.38	3,561	35		
Shoshone	301,619	346.41	7,226,945	1,187,572	246,389,593	52,247,088
	313,047	2,860.60	7,459,724	1,862,618	253,927,260	53,541,245
Total, 1926	293,499	2,208.34	6,137,680	1,043,207	223,825,731	52,584,197

BY KINDS OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	515	687.45	13,190	2,638	4,581	
Copper	1,922	568.93	47,388	910,599	7,000	
Lead	245,083	1,286.13	6,056,315	567,562	247,450,176	
Zinc	50,613	184.97	198,209	104,234	2,743,562	43,512,776
Copper-lead	1,931		1,050,507	255,682	1,248,430	
Lead-zinc	12,983	133.12	94,115	21,903	2,473,511	10,028,469

Mine production of metals from Idaho crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	14	5.76	4	19		
Adams	11	.22	57	3,370		
Bear Lake	20		40		29,624	
Blaine	529	40.13	42,025	3,094	364,958	
Boise	55	180.03	4,210	166	1,695	
Bonner	2,685	.78	115,939	2,854	1,971,928	
Butte	7	2.86	381	87	772	
Custer	1,505	207.16	35,994	113,669	222,557	
Lemhi	14,295	532.11	207,360	67,632	7,987,520	
Owyhee	28	156.35	2,258	44	1,716	
Shoshone	54,588	17.77	1,029,177	119,201	37,507,022	15,100
Washington	25	.03	186	409	23,371	
	73,762	1,143.20	1,437,631	310,545	48,111,163	15,100
Total, 1926	75,295	1,068.67	1,415,024	294,032	49,140,953	30,494

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	113	344.29	8,482	554	3,411	
Copper	1,180	225.45	2,235	119,749		
Lead	72,292	572.34	1,396,904	181,525	48,023,385	
Copper-lead	125	1.12	29,240	8,717	68,327	
Lead-zinc	52		770		16,040	15,100

REVIEW BY COUNTIES AND DISTRICTS

Previous issues of this annual report on metal mining in Idaho have reviewed the statistics of gold, silver, copper, lead, and zinc production and recorded significant details of mining and metallurgic activities by counties and for most of the mining districts. Long-continued shortage of personnel in the division of mineral statistics, of the Bureau of Mines, has so delayed the preparation of the report that the review is omitted except for the following tabular statement relating to the Coeur d'Alene mining region.

The report[2] of the mine inspector of Idaho contains notes on the progress of the mining industry, lists the active companies, and gives an interesting bibliography for each county.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, Idaho, 1926–27, and total, 1884–1927

Year	Lode mines	Placers	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc	Total value
			Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1926	58	4	[a]1,850,519	[b]$71,134	[b]6,952,074	962,447	257,667,986	52,533,485	$29,097,421
1927	49	5	[a]1,919,309	[b]8,596	[b]8,256,126	1,306,773	283,896,615	52,262,188	26,091,273
Total, 1884–1927	------	------	([c])	7,139,691	229,152,602	77,697,406	[d]3,798,772	605,549,659	647,604,171

[a] Includes old tailings, as follows: 1926, 33,373 tons concentrated and 3 tons sold to a smelter; 1927, 172,819 tons concentrated.

[b] Includes placer production, as follows: 1926, $46,365 in gold and 228 ounces of silver; 1927, $1,067 in gold and 4 ounces of silver.

[c] Figures not available.

[d] Short tons.

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[2] Campbell, Stewart, Twenty-ninth Annual Report of the Mining Industry of Idaho, for 1927.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By C. N. Gerry[1]

SUMMARY

The value of the mine production of gold, silver, copper, lead, and zinc in Washington in 1927 was 8 per cent less than that in 1926. The increase in the value of gold, copper, and zinc was more than offset by the large decrease in lead; there was also a decrease in silver. The largest decreases were in silver, lead, and zinc from Stevens County; there was a marked increase in the gold from Ferry and Whatcom Counties. The total value of the metal output of Washington in 1927 was less than the yearly average for the decade 1918 to 1927, which was about $944,300.

Since 1860 Washington has yielded an output of the five metals, as follows: Gold, $29,920,932; silver, 9,104,944 fine ounces; copper, 23,070,915 pounds; lead, 59,957,402 pounds; and zinc, 12,775,090 pounds. The total value has been $45,929,871, of which 65 per cent represents the value of the gold. Dividends paid by the Gladstone Mountain Mining Co. in 1927 from mining operations in the State amounted to $39,657.

The value of the metal output of Stevens County decreased nearly $400,000 because of decreased shipments of lead ore from the Gladstone mine near Northport, but large increases were shown in Ferry and Whatcom Counties.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

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[1] The valuable assistance of B. N. Lowry and Paul Luff, of the Bureau of Mines, is acknowledged.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1. 00	$0. 247	$0. 071	$0. 091	1923	$0. 82	$0. 147	$0. 070	$0. 068
1919	1. 12	. 186	. 053	. 073	1924	. 67	. 131	. 080	. 065
1920	1. 09	. 184	. 080	. 081	1925	. 694	. 142	. 087	. 076
1921	1. 00	. 129	. 045	. 050	1926	. 624	. 140	. 080	. 075
1922	1. 00	. 135	. 055	. 057	1927	. 567	. 131	. 063	. 064

Mine production of gold, silver, copper, lead, and zinc in Washington, 1918–1927

Year	Mines producing		Ore and old tailings (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1918	74	10	138, 911	14, 737. 83	$304, 658	310, 093	$310, 093
1919	42	7	100, 879	12, 232. 20	252, 862	259, 384	290, 510
1920	35	9	85, 318	5, 846. 60	120, 860	199, 678	217, 649
1921	26	11	22, 885	6, 215. 51	128, 486	142, 450	142, 450
1922	33	13	36, 016	9, 044. 43	186, 965	205, 046	205, 046
1923	30	6	56, 900	16, 547. 49	342, 067	227, 187	186, 293
1924	30	4	44, 383	14, 977. 72	309, 617	213, 742	143, 207
1925	37	9	50, 287	11, 138. 49	230, 253	166, 425	115, 499
1926	49	9	54, 343	9, 340. 82	193, 092	171, 649	107, 109
1927	30	3	119, 201	19, 513. 51	403, 380	155, 850	88, 367

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	1, 922, 406	$474, 834	5, 271, 815	$374, 299	38, 873	$3, 537	$1, 467, 421
1919	1, 676, 576	311, 843	2, 146, 157	113, 746			968, 961
1920	1, 983, 134	364, 897	5, 787, 247	462, 980	426, 496	34, 546	1, 200, 932
1921	251, 544	32, 449	143, 553	6, 460	449, 360	22, 468	332, 313
1922	317, 203	42, 822	1, 381, 199	75, 966	1, 228, 229	70, 009	580, 808
1923	871, 999	128, 184	2, 906, 479	203, 454	3, 024, 535	205, 668	1, 065, 666
1924	928, 458	121, 628	3, 935, 376	314, 830	910, 890	59, 208	948, 490
1925	1, 159, 057	164, 586	5, 627, 241	489, 570	1, 217, 846	92, 556	1, 092, 464
1926	1, 351, 890	189, 265	4, 546, 228	363, 698	1, 044, 354	78, 327	931, 491
1927	1, 685, 848	220, 846	955, 003	60, 165	1, 279, 710	81, 901	854, 659

Gold and silver produced at placer mines in Washington, 1918–1927, in fine ounces

Year	Gold	Silver	Year	Gold	Silver
1918	165. 93	45	1923	73. 09	23
1919	60. 32	18	1924	33. 77	12
1920	71. 20	16	1925	52. 87	11
1921	148. 66	48	1926	1, 354. 50	456
1922	162. 44	49	1927	18. 82	5

GOLD

The mine production of gold in Washington in 1927 was more than twice that in 1926 because of the large increases in the output of Ferry and Whatcom Counties. Ore shipped direct to smelters yielded nearly 78 per cent of the total gold, and ore amalgamated yielded nearly 22 per cent. About 77 per cent of the total gold was recovered from gold ore from mines at Republic, Ferry County. The chief producers of gold were the Quilp and Last Chance mines at Republic and the Boundary Red Mountain mine in Whatcom County; the Insurgent mine at Republic also produced considerable gold.

SILVER

The mine production of silver in Washington in 1927, most of which came from the Republic district, Ferry County, decreased 9 per cent in quantity compared with 1926. An increase of 56,000 ounces was recorded in the output of Ferry County, but a decrease of 71,000 ounces in that of Stevens County. Crude ore shipped to smelters yielded 87 per cent of the total silver and concentrates nearly all the remainder. Gold ore yielded 74 per cent of the total silver, copper ore 23 per cent, and lead ore and zinc ore and old tailings nearly 3 per cent. The Last Chance mine was the largest producer of silver, followed by the Quilp mine and the mines of the Northport Smelting & Refining Co., all at Republic; the Chewelah Union property at Chewelah and the Sunset mine near Index were also large producers.

COPPER

The mine production of copper in Washington in 1927 increased 25 per cent in quantity compared with 1926 and was more than the annual average output for the decade 1918 to 1927. A little crud copper ore was shipped from Chewelah, Stevens County; Index, Snohomish County; and Glacier Basin, Pierce County. The Sunset Copper Co. near Index was the only large producer of copper in the State; its output of copper ore increased considerably.

LEAD

The mine production of lead in Washington in 1927 decreased 79 per cent in quantity compared with 1926 as a result of the decrease in the shipments of lead ore from Northport, Stevens County. The Gladstone mine near Northport was the largest producer of lead, although its output decreased about 3,000,000 pounds; the Electric Point, Sullivan, and Grandview mines followed in order.

ZINC

The mine production of zinc in Washington in 1927 increased nearly 23 per cent in quantity compared with 1926 as a result of the increased shipments of zinc concentrates from Metaline Falls, Pend Oreille County. The Pend Oreille Lead & Zinc Co. and the Grandview Mines (Inc.) completed their flotation plants and shipped zinc concentrate to Cleveland, Ohio, and lead concentrate to Bradley, Idaho. The Pend Oreille Lead & Zinc Co. was the largest producer of zinc; the Black Rock mine near Northport was second, although its output decreased considerably; and the Grandview mine at Metaline Falls also produced much zinc.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1927, by counties

County	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
Chelan	20.51	$424	5	$3
Ferry	15,083.57	311,805	114,863	65,127
King	37.97	785	303	172
Kittitas	18.82	389	5	3
Pend Oreille	11.03	228	2,913	1,651
Pierce	1.02	21	113	64
Snohomish	132.98	2,749	17,476	9,909
Stevens	7.60	157	19,952	11,313
Whatcom	4,200.01	86,822	220	125
	19,513.51	403,380	155,850	88,367
Total, 1926	9,340.82	193,092	171,649	107,109

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Chelan	53	$7					$434
Ferry							376,932
King			1,354	$85			1,042
Kittitas							392
Pend Oreille	1,075	141	290,861	18,324	936,576	$59,941	80,285
Pierce	12,407	1,625					1,710
Snohomish	1,602,438	209,919					222,577
Stevens	69,875	9,154	662,788	41,756	343,134	21,960	84,340
Whatcom							86,947
	1,685,848	220,846	955,003	60,165	1,279,710	81,901	854,659
Total, 1926	1,351,890	189,265	4,546,228	363,698	1,044,354	78,327	931,491

Ore and old tailings sold or treated, lode mines producing, and average value of ore and old tailings in gold and silver in Washington, 1926 and 1927, by counties

County	Ore and old tailings (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1926	1927	1926	1927	1926	1927
Chelan		10		2		$42.70
Ferry	17,597	36,945	9	7	$11.01	10.20
King	60	25	1	1	39.13	38.28
Okanogan	18		2		6.94	
Pend Oreille	813	35,348	12	4	1.51	.05
Pierce	7	47	1	1	.43	1.81
Snohomish	25,290	37,097	2	2	.61	.34
Stevens	10,558	3,267	22	12	5.59	3.51
Whatcom		6,462		1		13.46
	54,343	119,201	49	30	5.00	4.12

MINING INDUSTRY

The total value of the metal output of Washington in 1927 was less than that of 1926 on account of the decrease in shipments of lead ore from near Northport and the general decrease in metal prices. At the leading camps conditions were favorable for mining, as shown in the decided increase in gold production. Unusual activity in mining and development work was reported from the Metaline district, Pend Oreille County, and from mines in Chelan, Snohomish, and Stevens Counties.

ORE CLASSIFICATION

Ore and old tailings sold or treated in Washington, 1918-1927, with content in terms of recovered metals

Year	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	DRY AND SILICEOUS ORE					
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	47, 151	14, 107. 36	156, 772	14, 448	23, 095	
1919	29, 086	12, 016. 93	104, 980	2, 463	143	
1920	13, 096	5, 549. 82	45, 977	2, 073	1, 743	
1921	20, 199	6, 015. 38	68, 991	3, 293	3, 339	
1922	24, 782	8, 830. 87	106, 243	2, 189	17, 759	
1923	33, 499	16, 348. 92	127, 029	349	4, 467	
1924	17, 575	14, 706. 15	70, 178	510		
1925	15, 383	10, 876. 19	43, 083	16		
1926	17, 599	7, 707. 83	56, 556	522		
1927	43, 450	19, 342. 20	115, 684	53	1, 929	
	COPPER ORE					
1918	83, 583	463. 82	149, 858	1, 907, 565		
1919	68, 447	153. 01	146, 891	1, 669, 060		
1920	62, 814	223. 59	146, 820	1, 975, 604		
1921	1, 332	24. 91	65, 716	246, 017		
1922	6, 086	38. 40	68, 239	312, 912	239	
1923	11, 128	80. 01	60, 805	855, 152		
1924	15, 916	117. 70	44, 173	927, 407		
1925	19, 500	139. 80	37, 131	1, 158, 812		
1926	25, 297	190. 98	18, 456	1, 348, 545		
1927	37, 564	139. 00	35, 926	1, 684, 450		
	LEAD ORE					
1918	8, 125	0. 72	3, 418	393	5, 248, 720	
1919	3, 281	1. 60	5, 251	1, 028	2, 118, 886	
1920	8, 660	1. 99	4, 123		5, 753, 976	
1921	354	26. 56	7, 695	2, 234	136, 974	
1922	3, 624	12. 72	30, 463	2, 102	1, 363, 201	
1923	7, 881	43. 44	36, 819	1, 341	2, 859, 032	
1924	8, 111	120. 10	99, 300	541	3, 916, 260	
1925	11, 518	57. 43	77, 618	24	5, 591, 348	
1926	7, 659	75. 27	82, 733	2, 823	4, 450, 458	
1927	1, 648	7. 26	1, 939	270	824, 423	
	COPPER-LEAD ORE					
1918						
1919	65	0. 34	2, 244	4, 025	27, 128	
1920	90		2, 742	5, 457	25, 708	
1921-22						
1923	942	2. 03	2, 511	15, 157	42, 980	
1924-27						
	ZINC ORE AND LEAD-ZINC ORE					
1918	52					38, 873
1919						
1920	658				5, 820	426, 496
1921	1, 000				3, 240	449, 360
1922	1, 554		52			1, 228, 229
1923	3, 450					3, 024, 535
1924	2, 781		79		19, 116	910, 890
1925	3, 886	12. 20	8, 582	205	35, 893	1, 217, 846
1926	3, 788	12. 24	13, 448		95, 770	1, 044, 354
1927	36, 539	6. 23	2, 296	1, 075	128, 651	1, 279, 710

Ore and old tailings sold or treated in Washington in 1927, with content in terms of recovered metals

Source	Mines producing	Ore and old tailings		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	11	43,442	36.45	19,342.06	99.12	115,391	74.04
Dry silver ore	2	8	.01	.14		293	.19
Copper ore	5	37,564	31.51	139.00	.71	35,926	23.05
Lead ore	9	1,648	1.38	7.26	.04	1,939	1.25
Zinc ore	3	[1] 35,307	29.62	6.23	.03	2,134	1.37
Lead-zinc ore	1	1,232	1.03			162	.10
Total, lode mines	[2] 30	119,201	100.00	19,494.69	99.90	155,845	100.00
Total, placers	3			18.82	.10	5	
	33	119,201	100.00	19,513.51	100.00	155,850	100.00
Total, 1926	58	54,343		9,340.82		171,649	

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	53		1,354	0.14		
Dry silver ore			575	.06		
Copper ore	1,684,450	99.92				
Lead ore	270	.02	824,423	86.33		
Zinc ore	1,075	.06	37,788	3.96	1,211,152	94.64
Lead-zinc ore			90,863	9.51	68,558	5.36
	1,685,848	100.00	955,003	100.00	1,279,710	100.00
Total, 1926	1,351,890		4,546,228		1,044,354	

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[1] Includes 9,537 tons of old tailings concentrated.
[2] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

Value of metals from ore and old tailings sold or treated in Washington in 1927, by kinds of ore

Kind of ore	Ore and old tailings (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	43,442	$399,836	$65,427	$7	$85		$465,355
Dry silver ore	8	3	166		36		205
Copper ore	37,564	2,873	20,370	220,663			243,906
Lead ore	1,648	150	1,099	35	51,939		53,223
Zinc ore	35,307	129	1,210	141	2,381	$77,514	81,375
Lead-zinc ore	1,232		92		5,724	4,387	10,203
	119,201	402,991	88,364	220,846	60,165	81,901	854,267
Total, 1926	54,343	165,092	106,824	189,265	363,698	78,327	903,206

DRY AND SILICEOUS ORE

The gold ore in 1927, as for several years past, was largely siliceous smelting ore mined at Republic; the output was more than double that of 1926. The total value of metals recovered from gold ore was $465,355; the ore averaged $9.20 in gold and 2.66 ounces of silver to the ton.

A small quantity of silver ore was marketed in 1927, but no gold and silver ore was produced.

COPPER ORE

Copper ore yielded metals valued at $243,906 in 1927; the ore averaged 8 cents in gold and 0.96 ounce of silver to the ton and 2.24 per cent of copper. Nearly all the copper ore came from Index, Snohomish County; it was largely milling ore. A small concentration mill was constructed on the property of the old Turk mine near Fruitland, and a few cars of copper concentrate were shipped.

LEAD ORE

The metals recovered from lead ore were valued at $53,223. Most of the ore came from Northport, Stevens County, and Metaline Falls, Pend Oreille County; it yielded on the average 9 cents in gold and 1.18 ounces of silver to the ton, 25.01 per cent of lead, and a little copper.

ZINC ORE

The metals recovered from zinc ore and old tailings were valued at $81,375. Nearly all this material came from Metaline Falls, Pend Oreille County, and was of milling grade; milling ore came also from Northport, Stevens County. The total milling ore and old tailings averaged 2.04 per cent of recoverable zinc.

LEAD-ZINC ORE

The lead-zinc ore—1,232 tons—yielded on the average 0.13 ounce of silver to the ton, 3.69 per cent of lead, and 2.78 per cent of zinc; it all came from Metaline Falls and was of milling grade.

Ore and old tailings sold or treated in Washington in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Chelan	10	20.51	5	53		
Ferry	36,945	15,083.57	114,863			
King	25	37.97	303		1,354	
Whatcom	6,462	4,200.01	220			
	43,442	19,342.06	115,391	53	1,354	
Total, 1926	17,599	7,707.83	56,556	522		

COPPER ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Pierce	47	1.02	113	12,107		
Snohomish	37,097	132.98	17,476	1,602,438		
Stevens	420	5.00	18,337	69,605		
	37,564	139.00	35,926	1,684,150		
Total, 1926	25,297	190.98	18,156	1,318,545		

Ore and old tailings sold or treated in Washington in 1927, by counties, with content in terms of recovered metals—Continued

LEAD ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Pend Oreille	739	4.80	617		162,210	
Stevens	909	2.46	1,322	270	662,213	
	1,648	7.26	1,939	270	824,423	
Total, 1926	7,659	75.27	82,733	2,823	4,450,458	

ZINC ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Pend Oreille	[1]33,377	6.23	2,134	1,075	37,788	868,018
Stevens	1,930					343,134
	35,307	6.23	2,134	1,075	37,788	1,211,152
Total, 1926	3,185					861,904

[1] Includes 9,537 tons of old tailings concentrated.

Zinc ore and zinc concentrates (as marketed from Washington mines and mills) sold to smelters in 1927

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized zinc ore	Stevens	58	33,500	28.88	26,840
Zinc concentrates	Pend Oreille and Stevens	1,365	1,522,157	55.76	1,252,870
		1,423	1,555,657	54.66	1,279,710

METALLURGIC INDUSTRY

Of the total ore and old tailings from Washington treated in 1927 more than 5 per cent was ore amalgamated (nearly all from the Boundary Red Mountain mine in Whatcom County), more than 62 per cent was ore and old tailings concentrated, and 32 per cent was crude ore shipped for smelting.

Six milling plants in Washington were active in 1927. Two used flotation, 2 table concentration, 1 a combination of flotation and table concentration, and 1 amalgamation.

Ore and concentrates from mines in Washington were smelted mainly at Bradley, Idaho; Tacoma, Wash.; Cleveland, Ohio; Great Falls, Mont.; and Trail, British Columbia. Lead ore and concentrate were smelted at the Bunker Hill plant at Bradley, Idaho; copper material at Tacoma, Wash.; and siliceous ore at Trail, British Columbia. Zinc concentrate was roasted and leached near Great Falls, Mont., and some was shipped to Cleveland, Ohio. An unusually complete plant for milling, smelting, and refining was operated at Trail, British Columbia. The Consolidated Mining & Smelting Co. treated company ore and custom material, all refining being done locally.

The ore and old tailings concentrated yielded 4,401 tons of concentrates, of which more than half was copper concentrate and nearly all the remainder zinc concentrate.

Nearly all the ore shipped crude to smelters was gold ore from Ferry County. The output of first-class lead ore decreased materially, but the output of siliceous ore was more than double that of 1926.

Mine production of metals from Washington concentrates in 1927

BY COUNTIES

	Ore and old tailings to concentrating mills		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Pend Oreille	25,757	9,537	1,282	11.03	2,850	1,075	252,025	936,576
Snohomish	37,000		2,736	130.00	17,023	1,576,723		
Stevens	2,118		383		66	21,714	23,235	316,294
	64,875	9,537	4,401	141.03	19,939	1,599,512	275,260	1,252,870
Total, 1926	28,836		3,182	179.91	30,403	1,221,028	144,029	1,002,200

BY KINDS OF CONCENTRATES

	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
Copper	2,789	130.00	17,062	1,598,437		
Lead	247	11.03	2,877	1,075	250,209	
Zinc	1,365				25,051	1,252,870

Mine production of metals from Washington crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Chelan	4	10.00	3	53		
Ferry	36,945	15,083.57	114,863			
King	25	37.97	303		1,354	
Pend Oreille	54		63		38,836	
Pierce	47	1.02	113	12,407		
Snohomish	97	2.98	453	25,715		
Stevens	1,149	7.60	19,886	48,161	639,553	26,840
	38,321	15,143.14	135,684	86,336	679,743	26,840
Total, 1926	23,664	7,269.26	139,303	130,862	1,402,199	42,154

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	36,982	15,131.68	115,462	53	1,929	
Copper	362	9.00	18,864	86,013		
Lead	919	2.46	1,358	270	677,814	
Zinc	58					26,840

REVIEW BY COUNTIES AND DISTRICTS

Previous issues of this annual report on metal mining in Washington have reviewed the statistics of gold, silver, copper, lead, and zinc production and recorded significant details of mining and metallurgic activities by counties and for most of the mining districts. Long-continued shortage of personnel in the division of mineral statistics, of the Bureau of Mines, has so delayed the preparation of the report that the review is omitted.

GOLD AND SILVER

(GENERAL REPORT)

By J. P. DUNLOP

DOMESTIC PRODUCTION

Approximate distribution, by producing States and Territories, of the production of gold and silver in the United States in 1927

[Figures supplied by the U. S. Bureau of the Mint]

State or Territory	Gold		Silver	
	Fine ounces	Value [1]	Fine ounces	Value [2]
Alaska	286, 298	$5, 918, 300	606, 129	$343, 675
Arizona	203, 088	4, 198, 200	6, 601, 467	3, 743, 032
California	564, 981	11, 679, 200	1, 557, 812	883, 279
Colorado	259, 111	5, 356, 300	3, 941, 351	2, 234, 746
Georgia	15	300	4	2
Idaho	15, 209	314, 400	8, 928, 619	5, 062, 527
Illinois			1, 500	850
Michigan			51, 742	29, 338
Missouri			87, 218	49, 453
Montana	56, 076	1, 159, 200	11, 809, 765	6, 696, 137
Nevada	149, 445	3, 089, 300	5, 372, 900	3, 046, 134
New Mexico	26, 098	539, 500	754, 878	428, 016
North Carolina	34	700	134	76
Oregon	14, 425	298, 200	41, 673	23, 629
Pennsylvania	126	2, 600	2, 299	1, 303
Philippine Islands	79, 872	1, 651, 100	40, 242	22, 817
South Dakota	322, 681	6, 670, 400	95, 123	53, 935
Tennessee	426	8, 800	82, 275	46, 650
Texas	324	6, 700	942, 971	534, 664
Utah	199, 518	4, 124, 400	19, 353, 758	10, 973, 581
Vermont			938	532
Washington	19, 398	401, 000	161, 643	91, 652
	2, 197, 125	45, 418, 600	60, 431, 111	34, 266, 328

[1] Gold valued at $20.67+ a fine ounce.

[2] Silver valued at 56.7 cents a fine ounce. Average New York price of bar silver.

The figures in this table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two bureaus. They are therefore final for both.

The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the Bureau of Mines directly from the producing mines and tabulated for the mine reports discussed later. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is small.

Increase or decrease in production of gold and silver in the United States in 1927, by States

State or Territory	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
Alaska	−38,888	−$803,900	−101,325	−$97,776
Arizona	−29,112	−601,800	−915,241	−947,394
California	−16,719	−345,600	−420,144	−350,965
Colorado	−87,186	−1,802,300	−1,096,223	−908,700
Georgia	−125	−2,600	−7	−5
Idaho	+2,569	+53,100	+1,364,975	+342,813
Illinois			−1,581	−1,072
Michigan			−55,352	−37,489
Missouri			+15,379	+4,626
Montana	−1,631	−33,700	−164,492	−775,799
Nevada	−21,435	−443,100	−1,077,324	−978,506
New Mexico	+5,993	+123,900	+258,244	+118,116
North Carolina	−87	−1,800	+112	+62
Oregon	+1,122	+23,200	+12,812	+5,620
Pennsylvania	+20	+400	+820	+380
Philippine Islands	−16,554	−342,200	−5,551	−5,758
South Carolina	−15	−300		
South Dakota	+35,720	+738,400	+12,334	+2,275
Tennessee	+10	+200	−13,508	−13,119
Texas	+160	+3,300	+479,360	+245,371
Utah	+17,686	+365,600	−582,274	−1,466,503
Vermont			−1,010	−684
Virginia	−10	−200		
Washington	+10,565	+218,400	+5,691	−5,662
	−137,917	−2,851,000	−2,284,305	−4,870,169

Domestic smelters and refiners recovered 696,442 fine ounces of gold and 74,662,879 fine ounces of silver from foreign ores and bullion, a decrease of 41,617 ounces of gold and 1,611,130 ounces of silver, compared with the corresponding figures for 1926. The foreign ores and bullion came from many countries but, as usual in recent years, mainly from Mexico, Canada, and Peru.

The value of the new gold used in the arts and manufactures in the United States in 1927 was $32,857,491, or 72 per cent of the domestic production of the United States, compared with $43,268,236 in 1926. The quantity of new silver used for such purposes was 28,493,290 fine ounces, or 47 per cent of the total domestic output, compared with 29,407,601 ounces in 1926. In addition to the new gold used in the arts and industries in 1927, $26,461,237 in gold recovered from waste material was also utilized. The total quantity of silver (new and old) used in the arts and manufactures was 38,648,717 ounces, or about 760,000 ounces less than in 1926. It is estimated that about 8,000,000 ounces of silver was used in the photographic and chemical industries. In addition to the gold and silver derived from foreign and domestic ore and bullion, $22,798,876 in gold and 7,157,592 ounces of silver were recovered from old or obsolete jewelry, silverware, dental waste, and other material. Most of the silver recovered is now handled by private refineries.

PRICES OF SILVER

The average monthly prices of fine bar silver in New York in 1927 were as follows:

Price of silver per fine ounce in 1927, by months

January	$0.56118	August	$0.55029
February	.58210	September	.55757
March	.55620	October	.56347
April	.56711	November	.57787
May	.56592	December	.58267
June	.57057		
July	.56670	Average	.56680

The yearly price of silver trended downward steadily, in the main, from $1.337 and $1.339 in 1865 and 1866 to a low point of $0.507 in 1915. Considering the world trade and political situation during the last four years, the price has been remarkably stable. In 1927 the spread in the average monthly prices was only $0.03238 an ounce, and the highest monthly average price was that for December. The average prices in 1928 will probably approximate 2 cents higher than those for 1927, with no indications of any extensive fluctuation.

Price of silver per fine ounce, 1918–1927[1]

1918	$0.98	1923	$0.82
1919	1.09	1924	.67
1920	1.12	1925	.694
1921	1.00	1926	.624
1922	1.00	1927	.567

PRODUCTION OF GOLD AND SILVER SINCE 1792

Gold and silver produced in the United States, 1792–1927

The estimate for 1792–1872 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint]

Period	Gold		Silver	
	Fine ounces	Value	Fine ounces	Commercial value
1792–1847[1]	1,186,977	$24,537,000	309,500	$404,500
1848–1872	58,279,781	1,204,750,000	118,568,200	157,749,900
1873–1927	155,286,832	3,210,063,700	2,877,857,352	2,260,244,867
	214,753,590	4,439,350,700	2,996,735,052	2,418,399,267

[1] A careful investigation made by Philip B. Bekeart (Soc. California Pioneers Quarterly, Sept. 30, 1924) appears to have definitely fixed Jan. 19, 1848, as the date of the discovery of gold by James W. Marshall at Sutters Mill, Coloma, Eldorado County, Calif., and to have shown that the flakes (not a nugget) found by Marshall are now in the National Museum, Washington, D. C.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.807.

IMPORTS AND EXPORTS[2]

Value of gold and silver imported into and exported from the United States, 1926–27, by classes

	Imports	Exports	Excess of—	
			Imports	Exports
1926				
Gold:				
Contained in domestic ore and base bullion		$207,725		$207,725
Contained in foreign ore and base bullion	$20,872,276		$20,872,276	
Domestic bullion refined	874,633	9,536,867		8,662,234
Foreign bullion refined	71,130,166	1,281	71,128,885	
United States coin	53,971,385	104,349,771		50,378,386
Foreign coin	66,655,560	1,612,171	65,043,389	
	213,504,020	115,707,815	157,044,550	59,248,345
Excess imports over exports			97,796,205	
Silver:				
Contained in domestic ore and base bullion		53,573		53,573
Contained in foreign ore and base bullion	46,170,162	381	46,169,781	
Domestic bullion refined		73,961,544		73,961,544
Foreign bullion refined	21,098,685	14,581,915	6,516,770	
United States coin	1,559,943	542,470	1,017,473	
Foreign coin	767,146	3,117,681		2,350,535
	69,595,936	92,257,564	53,704,024	76,365,652
Excess exports over imports				22,661,628

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[1] New York dealers' buying price for 1918–19; average buying price of silver from domestic mines for 1920 to June 2, 1923; average New York price for all silver after that period.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Value of gold and silver imported into and exported from the United States, 1926–27, by classes—Continued

	Imports	Exports	Excess of—	
			Imports	Exports
1927				
Gold:				
Contained in domestic ore and base bullion		$330, 246		$330, 246
Contained in foreign ore and base bullion	$18, 110, 866	2, 350	$18, 108, 516	
Domestic bullion refined		54, 608, 475		54, 608, 475
Foreign bullion refined	87, 262, 450	21	87, 262, 429	
United States coin	71, 001, 720	146, 302, 604		75, 300, 884
Foreign coin	31, 160, 159	211, 404	30, 948, 755	
	207, 535, 195	201, 455, 100	136, 319, 700	130, 239, 605
Excess imports over exports			6, 080, 095	
Silver:				
Contained in domestic ore and base bullion		70, 157		70, 157
Contained in foreign ore and base bullion	32, 056, 952		32, 056, 952	
Domestic bullion refined	31, 795	59, 848, 110		59, 816, 315
Foreign bullion refined	20, 745, 549	13, 200, 447	7, 545, 102	
United States coin	902, 909	396, 482	506, 427	
Foreign coin	1, 336, 712	2, 109, 584		772, 872
	55, 073, 917	75, 624, 780	40, 108, 481	60, 659, 344
Excess exports over imports				20, 550, 863

DOMESTIC SUPPLY

The total excess of imports of gold over exports for the period 1916 to 1927 was $1,961,000,000. This gain in the domestic supply of gold is best illustrated by the following figures, which show the excess of imports over exports for each of these years: In 1916, $530,000,000; in 1917, $180,000,000; in 1918, $21,000,000; in 1920, $95,000,000; in 1921, $667,000,000; in 1922, $238,000,000; in 1923, $294,000,000; in 1924, $258,000,000; in 1926, $98,000,000; and in 1927, $6,000,000. Exports exceeded imports in 1919 by $292,000,000 and in 1925 by $134,000,000.

The domestic supply of new gold comes chiefly from dry and siliceous ore and from placer gravel worked largely by dredges. These two sources yielded 90.2 per cent of the domestic gold in 1915, whereas in 1926 they yielded 78.5 per cent and in 1927, 76.6 per cent. Considerable gold is recovered also from the refining of copper bullion, especially from copper ore produced at mines in Arizona, Nevada, and Utah. The natural tendency has been for the proportionate output from gold ore to decrease with declining yield from several of the principal gold camps and for that from copper ore to increase; the result is a general net decline in total yield of gold due to the preponderant proportion of the output that comes from gold and gold-silver ores. The proportionate output of gold from copper ore was 7.2 per cent in 1915, 16.4 per cent in 1926, and 17.4 per cent in 1927.

In 1927 the domestic supply of new silver came chiefly from lead ore, copper ore, lead-zinc ore, and dry and siliceous silver and silver-gold ores, in the proportion of 26.44, 24.41, 22.85, and 19.75, respectively, compared with 24.85, 27.27, 23.32, and 21.71 in 1926. In 1915 dry and siliceous ore yielded 36 per cent of the silver, copper ore 26 per cent, lead ore 27 per cent, and lead-zinc ore only 9 per cent. Thus the largest gain in the output of silver has been from lead-zinc ore and the greatest loss from dry and siliceous ore.

WORLD PRODUCTION OF GOLD

The estimated value of the gold produced in the world from 1860 to 1927, inclusive, was $16,280,320,700. In 1927 the estimated production of the world was $400,998,700, an increase over 1926 of nearly $1,000,000. There were increases of $6,830,500 in 1926, $25,607,400 in 1924, and $48,433,300 in 1923. There was a decrease of $202,400 in 1925 and successive annual decreases from 1915 to 1922. The production of the United States decreased $2,851,000 in 1927 and that of Mexico nearly $1,000,000. The production of Canada increased $1,867,000 in 1927, that of South Africa about $2,300,000, and that of Russia about $1,422,000. Most of the increase in world production of gold in recent years has been due to larger production of the Rand mines in South Africa, although the output of gold in Canada and Russia has increased and is likely to continue to increase.

The following table shows the output of gold by countries, as given by the Bureau of the Mint, with slight changes resulting from late information.

World production of gold, 1922–1927

Country	1922	1923	1924	1925	1926	1927
North America:						
Canada	$26, 116, 000	$25, 495, 400	$31, 532, 400	$35, 880, 800	$36, 263, 100	$38, 130, 100
Central America	2, 500, 000	2, 000, 000	1, 800, 000	2, 000, 000	1, 800, 000	1, 500, 000
Mexico	15, 469, 200	16, 158, 400	16, 480, 100	16, 309, 900	15, 972, 300	14, 990, 700
United States[1]	48, 849, 100	51, 734, 000	52, 277, 000	49, 860, 200	48, 269, 600	45, 418, 600
South America:						
Argentina	75, 000	80, 000	60, 000	55, 000	50, 000	20, 000
Bolivia	8, 400	8, 400	19, 900	8, 000	6, 900	5, 000
Brazil	3, 031, 900	2, 990, 700	2, 990, 700	2, 243, 000	2, 110, 800	2, 067, 200
Chile	1, 650, 200	1, 331, 200	1, 400, 000	1, 265, 500	1, 222, 400	1, 240, 300
Colombia	5, 700, 000	5, 700, 000	2, 000, 000	1, 582, 400	1, 481, 300	1, 500, 000
Ecuador	877, 600	877, 600	800, 000	900, 000	1, 291, 700	1, 328, 000
Guiana—						
British	224, 800	168, 900	131, 000	188, 300	134, 700	118, 100
French	1, 008, 200	922, 500	1, 312, 600	831, 400	935, 100	999, 600
Netherland	247, 900	263, 200	214, 000	204, 700	155, 600	158, 800
Peru	1, 683, 400	2, 488, 300	2, 459, 000	2, 433, 800	2, 485, 600	1, 915, 400
Uruguay	7, 000	200	200	----------	----------	----------
Venezuela	358, 900	358, 900	358, 900	631, 400	631, 300	813, 800
Europe:						
Austria	11, 300	15, 300	40, 500	38, 500	27, 200	2, 700
Czechoslovakia	171, 400	69, 100	186, 100	156, 800	159, 500	155, 000
France	332, 300	350, 200	409, 400	701, 800	868, 400	930, 400
Germany	112, 300	132, 900	132, 900	120, 900	107, 600	103, 400
Greece	8, 600	8, 600	8, 000	----------	----------	10, 000
Italy	----------	25, 200	31, 900	39, 900	35, 200	41, 500
Rumania	888, 500	996, 900	871, 300	827, 400	1, 150, 400	1, 367, 800
Russia and Siberia	3, 032, 600	5, 181, 900	19, 805, 100	20, 364, 900	20, 509, 700	21, 931, 800
Spain	18, 700	18, 700	20, 000	20, 000	20, 000	20, 000
Sweden	700	----------	----------	----------	305, 700	305, 700
Turkey	29, 900	29, 900	19, 300	19, 300	19, 900	19, 900
Yugoslavia	143, 500	126, 900	161, 500	156, 800	214, 700	256, 500
Asia:						
China	2, 067, 200	1, 850, 100	2, 218, 100	2, 218, 100	2, 273, 900	2, 067, 200
Chosen	2, 643, 800	2, 510, 200	2, 772, 700	3, 035, 100	3, 940, 500	3, 927, 600
East Indies—						
British	600, 000	600, 000	500, 000	500, 000	400, 000	400, 000
Netherland	2, 156, 000	2, 388, 600	2, 571, 300	2, 743, 500	2, 384, 600	2, 337, 400
Federated Malay States	310, 200	190, 000	309, 200	292, 400	299, 200	221, 300
India, British	9, 054, 600	8, 729, 900	8, 193, 200	8, 140, 700	7, 937, 400	7, 943, 500
Indo-China	99, 700	128, 300	7, 200	7, 200	6, 600	6, 600
Japan	4, 833, 300	5, 111, 700	5, 054, 300	6, 557, 800	6, 364, 100	6, 366, 900
Sarawak	22, 700	20, 800	17, 700	14, 700	5, 000	5, 000
Taiwan	153, 900	453, 900	178, 800	186, 800	186, 800	186, 100
Africa	165, 774, 100	209, 954, 000	219, 579, 700	218, 759, 600	226, 580, 500	228, 870, 700
Australasia	18, 847, 200	18, 382, 600	16, 536, 800	13, 961, 800	13, 481, 600	13, 313, 100
	319, 420, 100	367, 853, 400	393, 460, 800	393, 258, 400	400, 088, 900	400, 998, 700

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[1] Includes Philippine Islands.

WORLD PRODUCTION OF SILVER

The decrease in the world production of silver in 1927 was 2,688,600 ounces. The largest increases were: Mexico, 6,282,700 ounces; Burma, 900,000 ounces; and Canada, 241,200 ounces. The United States and Canada produced 33 per cent of the total (34 per cent in 1926); Mexico, Central America, and South America produced 54 per cent; and all other countries—mainly Australasia, Burma, Japan, and Spain—produced only 13 per cent (33,469,500 ounces).

Most of the world output of silver is produced or refined in the United States, but a large part of it is consumed in Europe, India, and China; the price of silver has been dominated by the London market.

World production of silver, 1922–1927, in fine ounces

Country	1922	1923	1924	1925	1926	1927
North America:						
Canada	18, 581, 400	17, 754, 700	19, 736, 300	20, 229, 000	22, 371, 900	22, 613, 100
Central America	2, 000, 000	2, 500, 000	2, 686, 200	2, 700, 900	3, 499, 100	3, 154, 000
Mexico	81, 076, 900	90, 859, 100	91, 486, 100	92, 885, 500	98, 291, 200	104, 573, 900
United States[1]	56, 240, 100	73, 335, 200	65, 407, 200	66, 155, 400	62, 718, 700	60, 434, 400
South America:						
Argentina	25, 000		20, 000	18, 000	15, 000	15, 000
Bolivia	5, 373, 500	5, 212, 800	4, 857, 660	4, 346, 500	5, 834, 000	5, 402, 800
Brazil	25, 700	28, 600	28, 600	1, 800	20, 700	20, 000
Chile	2, 709, 200	3, 337, 500	3, 357, 700	3, 261, 700	2, 876, 900	2, 900, 000
Colombia	3, 200	3, 100	2, 900	2, 900	126, 000	131, 400
Ecuador	75, 000	75, 000	70, 000	70, 000	80, 000	87, 600
Guiana	9, 000	8, 500	8, 700	8, 500	8, 000	8, 000
Peru	13, 169, 800	18, 654, 800	18, 717, 100	19, 917, 400	21, 499, 800	18, 295, 400
Uruguay	2, 000					
Venezuela	2, 700	2, 700	2, 700	3, 200	3, 200	3, 200
Europe:						
Austria	8, 600	14, 200	28, 700	23, 900	14, 100	9, 700
Czechoslovakia	875, 200	702, 300	732, 500	707, 300	765, 500	750, 000
France	209, 000	213, 000	147, 900	352, 000	261, 800	308, 600
Germany	3, 581, 500	3, 753, 000	3, 753, 000	4, 780, 400	5, 358, 900	5, 500, 000
Great Britain	27, 600	34, 600	31, 100	32, 400	41, 300	46, 700
Greece	184, 100	184, 100	160, 700	254, 300	254, 300	241, 100
Italy	204, 700	385, 800	497, 000	320, 800	519, 400	537, 100
Norway	205, 200	297, 900	424, 400	504, 700	308, 600	321, 800
Poland			192, 900	212, 200	271, 700	
Rumania	83, 300	84, 800	72, 200	76, 600	93, 700	140, 700
Russia	150, 000	192, 900	250, 000	250, 000	250, 000	321, 500
Spain	2, 778, 200	2, 778, 200	2, 880, 000	3, 303. 900	3, 000, 700	3, 056, 600
Sweden		600			80, 400	80, 400
Turkey	8, 000	8, 000	219, 900	219, 900	225, 000	225, 100
Yugoslavia	26, 800	24, 600	31, 200	26, 100	45, 000	53, 800
Asia:						
Burma	4, 094, 300	4, 713, 100	5, 284, 200	4, 831, 500	5, 100, 000	6, 000, 000
China	100, 000	100, 000	110, 000	110, 000	135, 000	100, 000
Chosen	10, 700	39, 300	54, 700	70, 200	51, 900	52, 000
East Indies, Netherland	1, 109, 600	1, 579, 000	2, 083, 300	2, 385, 000	2, 363, 800	2, 285, 800
India, British	150, 000	150, 000	25, 000	23, 400	25, 000	24, 800
Indo-China						10, 200
Japan	3, 886, 300	3, 597, 400	3, 542, 300	4, 835, 500	4, 776, 100	4, 800, 000
Sarawak	500					
Taiwan	23, 400	23, 400	11, 000	13, 200	14, 300	15, 000
Africa:						
Algeria				96, 500	169, 100	118, 100
Bechuanaland				500	400	400
Belgian Congo	6, 500	8, 700				10, 600
British West Africa (Gold Coast, Ashanti, Nigeria		70				
East Africa, French	12, 900					
East Africa, Portuguese	500			1, 300	1, 100	700
Rhodesia	184, 400	161, 500	401, 300	158, 000	117, 800	131, 600
Tanganyika			700	1, 000	800	900
Transvaal, Cape Colony, Natal	1, 115, 700	1, 373, 900	1, 396, 900	1, 161, 500	981, 300	1, 011, 700
Australasia	11, 484, 900	13, 818, 700	10, 769, 900	10, 841, 000	11, 225, 400	7, 314, 600
	209, 815, 400	246, 011, 070	239, 481, 900	245, 193, 900	253, 796, 900	251, 108, 300

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[1] Includes Philippine Islands.

The exports of silver in 1927 were about 12,087,000 ounces less than in 1926. Exports of domestic refined silver bullion amounted to 106,151,908 ounces, of which 44,348,279 ounces went to China and 51,730,658 ounces to British India. Germany and the United Kingdom took 7,557,322 ounces. The figures show that the Orient continues to absorb most of the world's silver. Notwithstanding some sales by the Indian Government, the price of silver was remarkably free from fluctuations of any magnitude. This relative stability has extended to 1928, despite the precarious political situation in China. An interesting paper, entitled "Commercial Movement of Silver," by H. C. Simpson, was presented at the meeting of the San Francisco section of the American Institute of Mining and Metallurgical Engineers, September 6, 1928. The use of silver coinage in Europe has not expanded as anticipated; in fact, there has been a decided trend in most European countries toward debasing their silver coinage and selling the surplus silver. It is stated that the various governments have ample silver in stock for their needs and that it is doubtful if any 1928 silver will be purchased for coinage. Sales of silver have shown a substantial profit, and several of the countries have large stocks of unneeded silver. The Engineering and Mining Journal of September 22, 1928, page 475, contains an article by Charles T. Hallinan entitled "Silver Producers Missing a Chance." Mr. Hallinan thinks that producers of silver would have considerable influence in a campaign to bring about the use of more silver in European subsidiary coinage, as counterfeiting has increased enormously with the substitution of coins of debased metal. It has been estimated that the total quantity of silver used in subsidiary coinage decreased from 227,210,000 fine ounces in 1922 to 148,055,100 ounces in 1926.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the final official figures of the production of gold and silver in the United States in 1927 as agreed upon by the Bureau of the Mint and the Bureau of Mines. With the comparatively unimportant exceptions of domestic gold and silver contained in ore and matte exported for reduction during the year, these figures record the production of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace this total gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines makes a systematic investigation of the "mine production" of ores containing gold and silver and of the output of the placer mines, the output being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two plans for ascertaining the gold and silver production, one is a measure of the metallurgic industry and the other a measure of the mining industry; one reports the metal actually recovered in marketable form and the other the mine output and its recoverable content. The two methods will not produce exactly corresponding results, but the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error.

Gold and silver produced in the United States, 1905–1927, according to mint and to mine returns

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
		Fine ounces		*Fine ounces*
1905–1917	$1,214,627,100	817,973,439	$1,206,224,867	821,821,269
1918	68,646,700	67,810,139	67,701,936	68,063,090
1919	60,333,400	56,682,445	58,225,112	51,907,869
1920	51,186,900	55,361,573	50,537,281	56,559,022
1921	50,067,300	53,052,441	49,788,750	46,359,147
1922	48,849,100	56,240,048	48,932,109	61,235,983
1923	51,734,000	73,335,170	51,400,382	70,393,639
1924	52,277,000	65,407,186	52,180,812	64,113,882
1925	49,860,200	66,155,424	49,645,444	66,776,275
1926	48,269,600	62,718,746	48,075,596	62,533,373
1927	45,418,600	60,434,441	45,242,438	59,656,876
	1,741,269,900	1,435,171,052	1,727,954,727	1,429,420,425

These figures show, according to the reports of the mint, a total excess of gold for the 23 years of $13,315,173, or a difference of 0.77 per cent, and a total excess of silver of 5,750,627 ounces, or a difference of 0.4 per cent. The small differences are fully accounted for in the detailed discussions of the subject in previous reports of this series.

UNITS OF MEASUREMENT

In the measurement of ores and concentrates the short ton of 2,000 pounds is used throughout. The price of gold is fixed by law at $20.67+ per fine ounce. The annual average prices for silver from 1918 to 1927 are given on page 601.

PRODUCTION OF GOLD AND SILVER REPORTED FROM THE MINES

Mine production of gold and silver in the United States in 1927, by States

State or Territory	Gold		Silver		Increase or decrease from 1926	
	Fine ounces	Value	Fine ounces	Value	Gold	Silver (fine ounces)
Alaska	286,718.62	$5,927,000	627,800	$355,962	−$780,000	−62,200
Arizona	200,494.59	4,144,591	6,847,680	3,882,635	−692,845	−533,347
California	564,585.50	11,671,018	1,620,242	918,677	−252,463	−402,218
Colorado	255,377.33	5,279,118	3,784,605	2,145,871	−1,798,915	−919,517
Georgia	50.41	1,042	7	4	−2,032	−2
Idaho	15,315.67	316,603	8,901,409	5,047,099	+34,034	+1,344,965
Illinois			1,518	861		−1,472
Michigan			97,193	55,109		−8,049
Missouri			233,931	132,638		+143,931
Montana	53,541.25	1,106,796	11,200,077	6,350,444	−143,935	−1,569,015
Nevada	150,346.16	3,107,931	5,397,179	3,060,200	−517,530	−1,121,804
New Mexico	29,241.87	604,483	890,083	504,677	+198,680	+439,149
North Carolina	49.10	1,015	5	3	−616	−16
Oregon	14,676.16	303,383	45,830	25,986	+29,624	+16,097
Pennsylvania	299.98	6,201	2,000	1,134	+5,751	+1,456
Philippine Islands	81,571.42	1,686,231	31,194	17,687	−238,957	−14,960
South Carolina					−313	
South Dakota	322,031.74	6,656,987	96,171	54,529	+878,611	+13,985
Tennessee	426.47	8,816	81,460	46,188	+194	−22,540
Texas	396.29	8,192	1,034,866	586,769	+5,922	+587,629
Utah	193,908.82	4,008,451	18,606,950	10,550,141	+230,405	−751,631
Vermont			821	465	−41	−1,144
Virginia					−220	
Washington	19,513.51	403,380	155,850	88,367	+210,288	−15,799
Wyoming	58.05	1,200	5	3	+1,200	+5
	2,188,602.94	45,242,438	59,656,876	33,825,449	−2,833,158	−2,876,497

The preceding table gives the quantity and value of the mine production of gold and silver in 1927, by States, as reported to the Bureau of Mines by the producing mines, and the increase or decrease by comparison with the corresponding figures for 1926.

The principal gold-producing States in 1927 were California, South Dakota, Alaska, Colorado, Arizona, Utah, and Nevada, and these seven States made 90 per cent of the total output. There was a change in 1927 in the ranking of the larger producing States: California retained the lead and Alaska was third in both years, but Colorado, which ranked second in 1926, fell to fourth place in 1927 and South Dakota rose from fourth to second. The only notable increases in gold output in 1927 were in New Mexico, South Dakota, Utah, and Washington; the large decreases were in Alaska, Arizona, California, Colorado, Montana, Nevada, and the Philippine Islands.

The principal silver-producing States in 1927 were Utah, Montana, Idaho, Arizona, Nevada, and Colorado, and these six States produced about 92 per cent of the total; their ranking order was the same as for the two preceding years.

About $29,772,000 in gold, or 68 per cent of the output of the United States (Philippine Islands excluded) in 1927, was produced by 25 companies, none of which produced less than $265,000. As in former years, the Homestake mine in South Dakota was much the largest producer; the Yuba Consolidated Goldfields in California ranked second by a large margin. Eight of these large properties were in California, 5 in Arizona, 3 each in Colorado and Utah, 2 each in Alaska and Nevada, and 1 each in Montana and South Dakota. Thirteen of these properties produced gold from dry and siliceous ore; 3 from gravel by dredging; 3 from copper ore; 2 from siliceous ore, lead ore, and lead-zinc ore; 1 from copper ore and lead-zinc ore; 1 from copper ore and siliceous ore; 1 from copper ore and lead ore; and 1 from copper ore, lead-zinc ore, and zinc ore.

Larger producers of gold in the United States in 1927, in order of output

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co	South Dakota	Whitewood	Dry and siliceous ore.
2	Yuba Consolidated Goldfields	California	Marysville	Dredging gravel.
3	Golden Cycle Mining & Reduction Co.[1]	Colorado	Cripple Creek	Dry and siliceous ore.
4	Alaska Juneau Gold Mining Co	Alaska	Juneau	Do.
5	Utah Copper Co	Utah	West Mountain	Copper ore and lead-zinc ore.
6	Natomas Co. of California	California	Oroville and Folsom	Dredging gravel.
7	United Verde Copper Co	Arizona	Verde	Copper ore and siliceous ore.
8	Empire Mines Co	California	Grass Valley	Dry and siliceous ore.
9	Kennedy Mining & Milling Co	do	Jackson	Do.
10	North Star Mines Co	do	Grass Valley	Do.
11	Smuggler Union Mining Co	Colorado	Upper San Miguel	Do.
12	Nevada Consolidated Copper Co	Nevada	Robinson	Copper ore.
13	Hammon Consolidated Gold Fields.	Alaska	Nome	Dredging gravel.
14	Phelps Dodge Corporation (Copper Queen).	Arizona	Warren	Copper ore and lead ore.
15	Portland Gold Mining Co	Colorado	Cripple Creek	Dry and siliceous ore.
16	Park Utah Consolidated Mines Co.	Utah	Blue Ledge and Snake Creek.	Dry and siliceous ore, lead ore, and lead zinc ore.
17	Original Sixteen to One (Inc.)	California	Alleghany	Dry and siliceous ore.
18	Calumet & Arizona Mining Co	Arizona	Warren	Copper ore.
19	Argonaut Mining Co	California	Jackson	Dry and siliceous ore.

[1] Custom mill. Includes ore from Cresson and other mines.

Larger producers of gold in the United States in 1927, in order of output—Continued

Rank	Operator	State	Mining district	Source of gold
20	Anaconda Copper Mining Co	Montana	Summit Valley (Butte).	Mainly copper ore, lead-zinc ore, and zinc ore.
21	Central Eureka Mining Co	California	Mother Lode	Dry and siliceous ore.
22	New Cornelia Copper Co	Arizona	Ajo	Copper ore.
23	Katherine Gold Mining Co	do	Union Pass	Dry and siliceous ore.
24	Elkoro Mines Co	Nevada	Jarbidge	Do.
25	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and siliceous ore.

Besides the output of these large operators, $13,784,200 in gold came from about 3,300 placer and lode mines, not including those in the Philippine Islands. Some of these properties made good outputs, but many of them produced small quantities; the average value of the output of the smaller mines was about $4,230.

The Benguet Consolidated Mining Co., Philippine Islands, according to its printed report, produced nearly $1,037,000 in gold in 1927. (See p. 616.) Only seven companies in the United States exceeded this output.

The output of silver from the 25 leading producing properties in 1927 was about 38,700,000 ounces, or 65 per cent of the total. Thirteen of these properties each produced more than 1,000,000 ounces, and none of them yielded less than 628,000 ounces. The largest output of silver was that of the mines operated by the Anaconda Copper Mining Co., followed by that of the Park Utah Consolidated Mines Co. and the Tintic Standard Mining Co. The California Rand mine in California and the Presidio mine in Texas were the largest producers of silver from ore that contained no appreciable quantity of any other metal. Nine of the 25 largest producers were in Utah, 4 in Arizona, 4 in Idaho, 2 each in Colorado, Montana, and Nevada, and 1 each in California and Texas. Four of these properties recovered silver from dry and siliceous ore; 3 from dry and siliceous ore, lead ore, and lead-zinc ore; 3 from copper ore; 3 from lead ore; 2 from copper ore, lead ore, and lead-zinc ore; 2 from lead ore and lead-zinc ore; 2 from dry and siliceous ore and lead ore; 2 from copper ore and lead ore; 1 from copper ore and zinc ore; 1 from copper ore and lead-zinc ore; 1 from copper-lead ore; and 1 from lead-zinc ore.

Larger producers of silver in the United States in 1927, in order of output

Rank	Operator	State	Mining district	Source of silver
1	Anaconda Copper Mining Co	Montana	Summit Valley (Butte).	Copper ore and lead-zinc ore.
2	Park Utah Consolidated Mines Co.	Utah	Blue Ledge and Snake Creek.	Dry and siliceous ore, lead ore, and lead-zinc ore.
3	Tintic Standard Mining Co	do	Tintic	Lead ore and siliceous ore.
4	Silver King Coalition Mines Co	do	Uintah	Lead ore and lead-zinc ore.
5	Federal Mining & Smelting Co	Idaho	Hunter and Warm Springs.	Do.
6	United Verde Copper Co	Arizona	Verde	Copper ore.
7	Hecla Mining Co	Idaho	Lelande	Lead ore.
8	Bunker Hill & Sullivan Mining & Concentrating Co.	do	Yreka	Do.

Larger producers of silver in the United States in 1927, in order of output—Continued

Rank	Operator	State	Mining district	Source of silver
9	Butte & Superior Mining Co	Montana	Summit Valley	Copper ore and zinc ore.
10	Bingham Mines Co	Utah	Tintic and West Mountain.	Dry and siliceous ore, lead ore, and lead-zinc ore.
11	Plutus Mining Co	do	Tintic	Dry and siliceous ore and lead ore.
12	Sunshine Mining Co	Idaho	Evolution	Copper-lead ore.
13	Presidio Mining Co	Texas	Shafter	Dry and siliceous ore.
14	Utah Copper Co	Utah	West Mountain	Copper ore and lead ore.
15	Calumet & Arizona Mining Co	Arizona	Warren	Copper ore.
16	Chief Consolidated Mining Co	Utah	Tintic	Lead ore, siliceous ore, and lead-zinc ore.
17	Rawley Mines (Inc.)	Colorado	Kerber Creek	Dry and siliceous ore.
18	Phelps Dodge Corporation	Arizona	Warren	Copper ore and lead ore.
19	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and copper ore.
20	Magma Copper Co	Arizona	Pioneer	Copper ore.
21	Betty O'Neal Mines Co	Nevada	Lewis	Lead ore.
22	California Rand Silver (Inc.)	California	Randsburg	Dry and siliceous ore.
23	Sunnyside Mining & Milling Co	Colorado	Eureka	Lead-zinc ore.
24	Tonopah Extension Mining Co	Nevada	Tonopah	Dry and siliceous ore.
25	Utah Delaware Mining Co	Utah	West Mountain	Copper ore, lead ore, and lead-zinc ore.

MINE PRODUCTION OF GOLD AND SILVER, BY STATES

ALASKA

Gold.—The total estimated production of gold from Alaska mines for the period 1880 to 1927, inclusive, is given by the United States Geological Survey as $366,235,000. The mine production in 1927 was $5,927,000, which was $780,000 less than in 1926. The yield from lode mines increased from $2,938,000 in 1926 to $2,945,000 in 1927, and that from placer mines decreased from $3,769,000 in 1926 to $2,982,000 in 1927. Twenty-eight dredges produced $1,740,000 of the placer gold; this was $551,000 less than the output of 32 dredges in 1926. The average recovery of gold by the dredges in 1927 was about 29 cents per cubic yard of gravel. The 4,352,000 tons of siliceous ore treated in 1927 yielded an average recovery of $0.687 in gold and silver to the ton, which is a very much lower recovery than that from siliceous ore in any of the States. In 1927 about 50 per cent of the output of gold came from gold-lode mines, compared with 43 per cent in 1926. The estimated recovery of gold from dredges for the period 1903 to 1927 is $33,890,474. New dredges have been installed at Nome and in other districts; these will, in a favorable season, tend to increase considerably the output of gold from dredging.

Silver.—The mine production of silver in Alaska in 1927 was 627,800 ounces. Copper ore yielded 525,100 ounces, siliceous ore 79,400 ounces, and placers 23,300 ounces. The great bulk of the silver from Alaska mines is contained in concentrates recovered from copper ore. The quantity of silver recovered from placer bullion and from mill bullion is remarkably small.

ARIZONA

Gold.—Of the mine production of gold in Arizona in 1927 ($4,144,591) placers contributed only $6,257. Of the production from lode mines, 15 per cent was from dry and siliceous ore, nearly 80 per cent from copper ore, and 4.5 per cent from lead ore. Yavapai County made an output of $1,381,741 and Cochise County $1,317,258. None of the other counties produced as much as $500,000. The gold recovered from ore and old tailings by amalgamation and cyanidation amounted to 23,118 ounces; that recovered from concentrates amounted to 51,512 ounces; and that recovered from crude ore shipped to smelters amounted to 124,371 ounces. The crude copper ore directly smelted amounted to 2,552,903 tons and yielded an average of about 94 cents in gold a ton.

Silver.—Of the mine production of silver in Arizona in 1927 (6,847,680 ounces), 5,702,270 ounces came from copper ore, 609,718 ounces from lead ore, and 461,321 ounces from dry and siliceous ore. Yavapai County produced 2,584,676 ounces and Cochise County 2,276,526 ounces, mainly from copper ore. Silver recovered from gold and silver ores by cyanidation amounted to 40,694 ounces and that by amalgamation to 746 ounces; concentrates yielded 1,828,311 ounces of silver; and crude ore shipped to smelters yielded 4,919,954 ounces.

ARKANSAS, MISSOURI, OKLAHOMA, ILLINOIS, AND KENTUCKY

The lead and zinc mines of the Central States produce no gold and very little silver. None of the zinc ores of Illinois, Kansas, Oklahoma, or Wisconsin yield silver; the lead concentrates of the Joplin region contain an average of only about one-tenth of an ounce of silver a ton and this silver is never recovered. Occasionally small shipments of copper ore from southeastern Missouri yield a small quantity of silver, but no copper ore was shipped from Missouri in 1927. The silver from southeastern Missouri mines in 1927 (233,931 ounces) was all derived from lead ore. Part of it was obtained in refining lead and from copper-lead matte shipped to smelters, but most of it was contained in zinc flotation concentrates derived from lead ores. The zinc concentrates were first treated at retort smelters and the residues containing the silver were treated at lead smelters. As the shipments of zinc flotation concentrates from southeastern Missouri will increase, the output of silver from this source will also be larger. The zinc concentrates carry from 18 to 20 ounces of silver a ton. The lead-fluorspar deposits of the Kentucky-Illinois field carry silver; 1,518 ounces of silver was recovered in 1927 from this source. The lead concentrates shipped from Illinois in 1927 yielded 4.9 ounces of silver a ton. No silver ore has been shipped from the Criswell mine, near Byars, Okla., since 1916; the Kellogg mine in Pike County, Ark., was not operated in 1926 or 1927.

CALIFORNIA

Gold.—In 1927 the total value of the production of gold from mines in California was $11,671,018 (a decrease of $252,463). The lode mines produced $5,833,705 compared with $6,695,078 in 1926. Of the 1927 output from lode mines 94 per cent came from dry and siliceous ore and nearly 6 per cent from copper ore. The total output of the placers in 1927 was $5,837,313, or $608,910 more than in 1926; of this total $5,461,929 came from dredges. The total dredge production from 1896 to the end of 1927 was $155,533,771. Seven

Yuba County dredges made the largest output, $3,460,133, and seven dredges in Sacramento County made an output of $1,211,278. The output of the once very productive dredging industry in Butte County was only $128,621. Nine dredges in Calaveras, Placer, Shasta, Stanislaus, and Trinity Counties produced $661,897.

Four of the 32 counties reporting mine production of gold had a yield of more than $1,000,000 each in 1927. Of these, Yuba and Sacramento Counties usually obtain nearly all of their gold by dredging, and Amador and Nevada Counties recover most of their production from siliceous ore. The five Mother Lode counties—Amador, Calaveras, Eldorado, Mariposa, and Tuolumne—whose output is mainly gold milling ore, produced 92,058 ounces of gold from mill bullion and 17,940 ounces from concentrates made from gold ore; the average value in gold and silver from the 302,007 tons of ore milled in 1927 was $7.57.

Silver.—The total production of silver from California mines in 1927 was 1,620,242 fine ounces, a decrease of 402,218 ounces from 1926. The only counties whose mines yielded more than 100,000 ounces were San Bernardino with 788,580 ounces, Plumas with 315,887 ounces, and Shasta with 123,917 ounces. Dry and siliceous ore yielded 64 per cent of the silver in 1927 and copper ore 24 per cent; lead ore and zinc ore each yielded about 4 per cent. Seventy-four per cent of the silver was recovered from ore sent to concentrating plants.

COLORADO

The total production of gold from Colorado for the period 1858 to 1927, inclusive, is estimated at $701,000,000 and that of silver at 645,000,000 fine ounces.

Gold.—The mine production of gold in Colorado in 1927 was $5,279,118, a decrease of $1,798,915 compared with 1926. The Cripple Creek district in Teller County produced $3,307,505; the San Juan region in Dolores, La Plata, Ouray, San Juan, and San Miguel Counties, $1,234,430; Lake County, $247,607; and the mines in other counties a total of $489,576. The gold produced from placer mines was only $94,434, while that from lode mines was $5,184,684; a dredge in Summit County yielded nearly all the gold from placers. Dry and siliceous ore, aggregating about 64.5 per cent of all ore treated, yielded 234,669 fine ounces of gold, or 92 per cent of the total yield of gold; lead-zinc ore yielded 5.3 per cent; and all other kinds of ore a little more than 1 per cent. The quantity of gold recovered by amalgamation and cyanidation was 191,317 ounces, that contained in concentrates was 49,313 ounces, and that in crude ore shipped to smelters 10,179 ounces.

Silver.—The output of silver from Colorado mines in 1927 was 3,784,605 ounces, nearly 920,000 ounces less than in 1926. Of this output, Lake County mines produced 411,471 ounces, mines in the San Juan region 1,893,838 ounces, and those in Saguache County 845,044 ounces. Siliceous and dry ores yielded 63.7 per cent of the silver, lead ore 6.5 per cent, and lead-zinc ore 29.2 per cent. Only 123,241 ounces of silver was recovered in bullion at gold and silver mills and 740,017 ounces from crude ore shipped to smelters. Most of the silver, 2,920,211 ounces, was derived from concentrates mainly from Saguache, San Juan, and San Miguel Counties.

IDAHO

Gold.—The total production of gold in Idaho from the discovery of placer gold in 1863 to the end of 1927 is estimated at $136,214,642. Of the total output of gold in Idaho in 1927, valued at $316,603, Boise County produced $152,249 and Elmore County $80,375. The value of the output of gold from placer mines in 1927 was $155,459 and that from lode mines $161,144. The total output of gold recovered by dredges for the period 1897 to 1927, inclusive, was $5,893,514; that for 1927 was $114,116 and was reported by two dredges in Boise County and one in Elmore County. Of the total gold in 1927, 49 per cent came from placers, 31 per cent from siliceous ore, 5 per cent from copper and copper-lead ores, and 12 per cent from lead ore. Of the gold recovered from ore, 49 per cent was recovered by amalgamation, mainly from mines in Boise County.

Silver.—The total mine production of silver in Idaho for the period 1863 to 1927, inclusive, amounted to 298,614,646 fine ounces. Of the 1927 output (8,901,409 ounces), 8,256,126 ounces was from the Coeur d'Alene region in Shoshone County. The only other county that produced more than 200,000 ounces of silver in 1927 was Lemhi County. Lead ore yielded 63 per cent of the silver in 1927, lead-zinc ore 24 per cent, copper-lead ore 12 per cent, and other classes of ores less than 1 per cent. Concentrates shipped yielded 7,459,724 ounces and crude ore shipped to smelters 1,437,631 ounces. Silver from placers and mill bullion amounted to little more than 4,000 ounces

MICHIGAN

The copper mines of Michigan produced 97,193 ounces of silver in 1927, part of it from lumps of native silver picked from ore mined but mainly from the electrolytic treatment of about 1,600,000 pounds of copper.

MONTANA

The total production of gold from Montana for the period 1904 to 1927, inclusive, was $73,574,865, and the total silver production for the same period was 301,540,332 ounces.

Gold.—Since the dredges in Montana ceased operating the output of gold from placers has dwindled, and the production in 1927 was only $22,325, whereas in 1921 it was $227,161. The value of the gold from lode mines in 1927 was $1,084,471, or $143,432 less than in 1926. Silver Bow County produced $543,939 of the total gold, most of it from copper ore; Lewis and Clark County produced $212,917, mainly from gold ore; no other county produced as much as $200,000. At amalgamation and cyanidation plants 9,674 ounces of gold was recovered from 33,936 tons of ore and 1,063 tons of old tailings. Concentrates from all sources (mainly from copper ore) yielded 35,246 ounces of gold, and crude ore shipped to smelters yielded 7,271 ounces. Dry and siliceous ore produced 34 per cent of the gold, copper ore 51 per cent, and lead-zinc ore 7 per cent.

Silver.—The total production of silver from Montana mines in 1927 (11,200,077 ounces) was 1,569, 015 ounces less than in 1926. Copper ore yielded 55 per cent of the total, lead-zinc ore nearly 19 per cent, and zinc ore 14 per cent. Silver Bow County (Butte) produced

9,659,142 ounces and the other counties 1,540,935 ounces. Bullion from mills contained only 30,372 ounces of silver and crude ore smelted only 608,722 ounces; the great bulk of the silver was derived from 4,014,106 tons of ore and old tailings concentrated. The 912,540 tons of concentrates recovered from all sources in Montana in 1927 yielded an average of 11.47 ounces of silver a ton.

NEVADA

The total production of gold from Nevada for the period 1904 to 1927, inclusive, was $202,206,433, and the total silver production was 235,591,750 ounces.

Gold.—The mine production of gold in Nevada in 1927 was $3,107,931; of this only $37,400 was from placer mines, a decrease of $21,849 from 1926. The larger producing counties were White Pine County with $996,452, mainly from copper ore; Nye County with $635,092, mainly from siliceous ore; and Elko County with $501,738 and Esmeralda County with $468,084, both mainly from siliceous ore. The gold production of White Pine County increased $242,750 in 1927, and that of Storey County (Comstock) decreased nearly $945,600. The yield of gold from siliceous ore declined greatly again in 1927, when the recovery from that source was only 63 per cent of the total, compared with 72 per cent in 1926. Copper ore yielded 31 per cent of the gold in 1927 as compared with 21 per cent in 1926.

Silver.—The mine production of silver in Nevada in 1927 was 5,397,179 ounces. The Tonopah district produced 2,167,694 ounces, or about 115,000 ounces more than in 1926; Storey County produced only 62,051 ounces, compared with 1,534,116 ounces in 1926; and Esmeralda County produced 1,117,058 ounces, or more than double its output in 1926. Dry and siliceous ore yielded 63 per cent of the silver and lead and copper-lead ores 31 per cent. Fifty-six per cent of the silver was recovered by cyanidation, nearly 28 per cent from concentrates, and 16 per cent from crude ore shipped to smelters.

NEW MEXICO

Gold.—The gold produced by mines in New Mexico in 1927 ($604,483) was nearly $200,000 more than in 1926. San Miguel County with $235,766 was the largest producer, due to the gold contained in lead-zinc ore concentrated at the Pecos mill near Glorieta; Hidalgo County mines produced $197,401, and those in Grant County $107,076. Copper ore yielded 14,443 ounces, lead-zinc ore 11,873 ounces, and dry and siliceous ore 2,516 ounces. Concentrates yielded 16,617 ounces and crude ore shipped to smelters 10,863 ounces. The output from placer mines was $5,808 in 1927, compared with $2,687 in 1926.

Silver.—The mine production of silver in New Mexico increased from 450,934 ounces in 1926 to 890,083 ounces in 1927. San Miguel County with 509,446 ounces and Grant County with 143,434 ounces were the only counties that produced more than 100,000 ounces in 1927. The production from siliceous ore was only 61,810 ounces. Lead-zinc ore yielded 637,510 ounces, copper ore 122,093 ounces, and lead and copper-lead ore 67,704 ounces. Most of the silver was derived from concentrates of copper ore and lead-zinc ore. The concentrates treated yielded 656,690 ounces and crude ore shipped to smelters 232,816 ounces.

OREGON

Gold.—The mine production of gold in Oregon in 1927 was $303,383, or $29,624 more than in 1926. The output of the lode mines ($119,686) was about $31,300 less than in 1926. Grant County produced $74,855 from lode mines, Josephine County $22,126, and Baker County $21,071. The production of the placer mines was $183,697, or about $61,000 more than in 1926. Grant County yielded $78,094 in placer gold and Baker County $61,234. Two dredges in Baker and Grant Counties produced $112,643 in gold. Jackson and Josephine Counties in western Oregon had a total output of gold valued at $64,356. Copper ore yielded 812 ounces of gold, and the remainder of the lode-mine gold was derived from siliceous ore.

Silver.—Of the total mine production of silver in Oregon in 1927 (45,830 ounces), 36,376 ounces came from siliceous ore, 8,299 ounces from copper ore, and 1,155 ounces from placer bullion. About 39,500 ounces of silver was recovered from concentrates and about 4,400 ounces from crude ore shipped to smelters.

SOUTH DAKOTA

The total value of gold produced in South Dakota from 1876 to 1927, inclusive, was $267,695,318, and the total output of silver for the same period was 7,489,099 ounces.

Gold.—The mine production of gold in South Dakota in 1927 ($6,656,987) was $878,611 more than in 1926. The output was derived almost wholly from low-grade siliceous milling ore. Nearly 65 per cent of the total output was recovered by amalgamation and 35 per cent by cyanidation. The Homestake mills treated 1,371,583 tons of ore from the Homestake mine; receipts from bullion product amounted to $6,679,802. Only 7 ounces of gold was obtained from ore directly concentrated and about 14 ounces from placer mines.

Silver.—The output of silver from South Dakota mines in 1927 was 96,171 ounces and, with the exception of 2,686 ounces, was derived from gold bullion produced at mills.

SOUTHERN APPALACHIAN AND EASTERN STATES

Gold.—The total production of gold for the period 1799 to 1927, inclusive, in the southern Appalachian States was $51,136,661. The data compiled credit Alabama with $766,746, Georgia with $17,844,173, Maryland with $71,405, North Carolina with $23,661,087, South Carolina with $5,182,618, Tennessee with $312,196, and Virginia with $3,298,436.

The mine production of gold in the southern Appalachian States in 1927 was $10,873, compared with $13,860 in 1926. Tennessee mines yielded $8,816 (all from copper ore), three placers in Georgia produced $1,042, three placers in North Carolina produced $1,015, and the remainder of the gold from the Eastern States was a by-product of copper concentrates derived from pyritiferous magnetite ore mined at the Cornwall mine in Pennsylvania. No siliceous ore was treated in 1927 except at experimental plants. The gold mines in Alabama, South Carolina, and Virginia were not productive in 1927.

Silver.—The mine production of silver in the Eastern States was 84,293 ounces in 1927, or 22,246 ounces less than in 1926. The copper ore of Ducktown, Tenn., yielded 81,460 ounces of silver, ore from the Cornwall mine in Pennsylvania 2,000 ounces, copper ore from Vermont 821 ounces, and placer mines in Georgia and North Carolina 12 ounces.

TEXAS

The total output of gold from Texas mines from 1885 to 1927, inclusive, is recorded as $54,871 and the output of silver for the same period as 20,022,146 ounces.

Gold.—The production of gold has been mainly a by-product. The mine output in 1927 was $8,192, the largest output for many years.

Silver.—The mine production of silver in 1927 was 1,034,866 ounces, mainly from the Presidio mine, operated by the American Metal Co.

UTAH

The total output of gold in Utah from 1864 to 1927, inclusive, is recorded as $121,875,938 and the total output of silver for the same period as 529,389,541 fine ounces.

Gold.—In 1927 the mine production of gold, all from lode mines, was $4,008,451, compared with $3,778,046 in 1926. Of the 1927 output of gold, the Tintic district yielded $646,049, the Bingham or West Mountain district $2,566,718, and the Park City district $667,649. Nearly 52 per cent of the Utah gold was derived from copper ore, about 26 per cent from lead-zinc ore, 10 per cent from lead ore, and nearly 12 per cent from dry and siliceous ore. The recovery of gold from concentrates was 140,505 ounces and that from crude ore shipped to smelters 44,818 ounces.

Silver.—The mine production of silver in Utah was about 751,600 ounces less in 1927 than in 1926. The output of mines in Juab County was 4,165,136 ounces; Salt Lake, Summit, Utah, and Wasatch Counties each produced more than 3,100,000 ounces. The Tintic district produced 7,591,406 ounces in 1927, the Bingham district 3,582,084 ounces, and the Park City district 6,935,267 ounces. Lead-zinc ore yielded 40 per cent of the total, lead ore 39 per cent, siliceous ore 14 per cent, and copper ore 6 per cent. Crude ore shipped to smelters in 1927 yielded 9,665,925 ounces of silver and concentrates 8,480,673 ounces.

WASHINGTON

The total production of gold in Washington from earliest mining to the end of 1927 is recorded as $29,920,932 and the total production of silver as 9,104,944 fine ounces.

Gold.—The mine output of gold in 1927 was the largest since 1917 and was $210,288 more than in 1926. The largest county production ($311,805) in 1927 was from Ferry County, mainly from the Republic district. Whatcom County mines, which produced only

$58 in 1926, produced $86,822 in gold in 1927. More than 99 per cent of the gold in 1927 was derived from siliceous ore. Only 141 ounces of gold was derived from concentrates, 19 ounces from placer mines, and 4,211 ounces from bullion made at milling plants; the rest of the gold, 15,143 ounces, was derived from crude ore shipped to smelters.

Silver.—Of the mine production of silver in 1927 (155,850 ounces), 114,863 ounces was from mines in Ferry County, all from siliceous ore. The output of silver from copper ore was 35,926 ounces, or slightly less than 1 ounce a ton; most of the copper ore was from mines in Snohomish and Stevens Counties.

WYOMING

The total production of gold in Wyoming from 1867 to the end of 1927 was $1,238,824 and the output of silver for the same period 70,118 ounces.

The mine production of gold in 1927 was $1,200 and that of silver 5 ounces, all recovered from siliceous ore milled.

PHILIPPINE ISLANDS

Gold.—The output of gold in the Philippine Islands from 1907 to 1927, inclusive, was $23,370,833. The production during the last 10 years was as follows:

1918	$1, 290, 000	1923	$1, 686, 327
1919	1, 309, 722	1924	1, 651, 796
1920	1, 276, 561	1925	1, 945, 990
1921	1, 313, 096	1926	1, 925, 188
1922	1, 526, 400	1927	1, 686, 231

The yield of gold in 1927 from lode mines producing siliceous ore was $1,633,836. The gold derived from placers, nearly all from dredging, amounted to $52,395.

An article [3] was published in 1927 giving data on operations in 1926 by the Benguet Consolidated Mining Co., the Balitoc Mining Co. (formerly known as the Acupan mines), the Itogan Mining Co., and the Ukap Mining Co., as well as development work at the Douglas, Comote, Kelly, and other mines and properties.

The annual report of the Benguet Consolidated Mining Co.[4] for 1927 states that the bullion recovered was $1,036,991, the gross profit $429,847, and the net profit $292,172. The controlling interest in the Balitoc mine, which is near the Benguet, was acquired, and a 100-ton mill under construction was to be ready for operation in October, 1928. A new hydroelectric power plant was being built; this plant will supply 1,000 kilowatts to supplement that of existing plants which supplied 1,130 kilowatts in 1927. Early in 1928 the Benguet mill was treating 8,000 tons of ore a month, and the reserves of ore had been considerably increased.

Silver.—The mine production of silver in 1927 (31,194 ounces) was derived entirely from gold bullion refined.

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[3] Eye, C. M., Philippine Gold Mining in 1926: Eng. and Min. Jour., Mar. 5, 1927, p. 414.

[4] Engineering and Mining Journal: Apr. 14, 1928, p. 633.

NUMBER OF PRODUCING MINES

The following table indicates the number of mines that produced gold and silver in 1927. The placers are those in which the gold and the silver that is in natural alloy with the gold and, in a few placers, with platinum also are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those producing gold and silver (from ore as distinguished from gravel) mainly from underground workings, including those whose ore is valuable chiefly for copper, lead, or zinc but which contribute precious metals as by-products. In addition to producing mines here enumerated, many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of lode mines, because some of the operations are only temporary and individually small and because much of the production is made by transitory miners not regularly working placer ground. The unit so far as possible is, as for lode mines, not the operator but the mining claim or group of claims.

Number of mines in the United States producing gold and silver in 1927, by States [1]

State or Territory	Placer	Lode	Total	State or Territory	Placer	Lode	Total
Alaska	450	25	475	North Carolina [2]	3		3
Arizona	15	293	308	Oregon	150	36	186
California	465	318	783	Pennsylvania [2]		1	1
Colorado	19	330	349	South Dakota	2	2	4
Georgia	3		3	Tennessee [2]		2	2
Idaho	70	148	218	Texas		4	4
Illinois [2]		2	2	Utah		123	123
Michigan [2]		1	1	Vermont		1	1
Missouri [2]		3	3	Washington	3	30	33
Montana	60	247	307	Wyoming		1	1
Nevada	30	379	409				
New Mexico	10	102	112		1,280	2,048	3,328

[1] Philippine Islands excluded.
[2] Number of mines contributing to production of gold and silver.

Number of mines in the United States producing gold and silver, 1918–1927

Year	Placer	Lode	Total	Year	Placer	Lode	Total
1918	1,414	3,287	4,701	1924	1,095	2,032	3,127
1919	1,105	2,460	3,565	1925	1,236	2,445	3,681
1920	1,012	2,331	3,343	1926	1,276	2,399	3,675
1921	1,357	1,967	3,324	1927	1,280	2,048	3,328
1922	1,359	2,206	3,565				
1923	1,295	2,188	3,483	Average	1,243	2,336	3,579

The total number of properties operated in 1927 was 251 less than the average for the last 10 years. Although the number of placer properties worked showed an increase of 4 compared with 1926, it was 1,036 less than the number operated in 1906. The general decline in number of placer operations is a natural result of the exhaustion of the rich gravel and of the acquisition of large areas o placer ground by dredge companies. The number of lode mines operated was 351 less than in 1926 and 288 less than the average for the last 10 years.

Increases in the number of lode mines operated were recorded in 1927 in Alaska and Nevada. The large decreases in number of lode mines operated were in Arizona, 69; California, 17; Colorado, 57; Idaho, 29; Montana, 88; New Mexico, 14; Oregon, 13; Utah, 41; and Washington, 19.

ORE PRODUCTION, CLASSIFICATION, AND AVERAGE VALUE

The best index of lode mining is found in the quantity, metallic content, and value of ore mined, rather than in the number of mines or of operators. In the next table are given the production of ore from mines producing gold and silver and the average extraction value of precious metals per ton.

The classification adopted is necessarily arbitrary in part. The complex nature of western ores especially and the gradations from one well-recognized class to another render essential a fixed terminology. The dry and siliceous ores comprise gold and silver ores proper, as well as fluxing ores carrying considerable quantities of iron and manganese oxides and very small quantities of gold and silver, and precious metal-bearing ores carrying copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The distinction between gold and silver ores is not here made. The total number of silver mines and the total production of true silver ore are both comparatively small. The copper ores include those containing 2.5 per cent or more of copper, or less than this percentage in the great disseminated copper deposits of the West and in the Lake Superior ores. In general, the lead ores are those containing 4.5 per cent or more of lead, and the zinc ores are those containing 25 per cent or more of zinc, both irrespective of their precious-metal content; but ores of lower grades in lead and especially in zinc are treated profitably in many districts, and, of course, they are then classified as lead or zinc ores, as the case may be. The mixed ores are combinations of those enumerated.

The lead, zinc, and lead-zinc ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver, and such ores are excluded from this report. With the increase in the use of flotation and the recovery of zinc concentrates from lead ore in southeastern Missouri there has been an increase in the total quantity of silver recovered in Missouri, as these zinc concentrates contain 18 to 20 ounces of silver a ton. Singularly, the lead concentrates from the lead ore treated in southeastern Missouri contain very little silver, approximately less than 5 per cent of that contained in the zinc concentrates. The proportion of silver derived from the total quantity of crude lead ore milled is very small.

The total quantity of ore sold or treated annually from which gold or silver was produced decreased from the record of 68,000,000 tons in 1918 to 21,500,000 tons in 1921. It then increased steadily until 1926 when the total was 65,787,864 tons; in 1927 the total was 64,526,920 tons.

The quantity of copper ore sold or treated in 1927 decreased 1,097,620 tons, or 2 per cent, largely because of decreased production of copper in Arizona, California, Montana, and New Mexico due to the low price of the metal, and the quantity of lead-zinc ore decreased 325,525 tons, or 9 per cent. The quantity of zinc ore was more than twice that of 1926, and there was also a large increase in the quantity of copper-lead ore. The quantity of dry and siliceous ore decreased nearly 200,000 tons, or 2 per cent, notwithstanding the large increase in Alaska.

Arizona led in quantity of ore by 6,234,800 tons, as its output was 99 per cent copper ore; Utah was second, because of its copper and lead-zinc ores; Nevada was third, with 88 per cent of its output copper ore; Alaska was fourth, with an output of which 87 per cent was dry and siliceous ore; and Montana, New Mexico, Idaho, Colorado, California, and South Dakota followed in order. The bulk of the ore from Montana and New Mexico was copper ore, that from Idaho lead and lead-zinc ore, that from Colorado and South Dakota dry and siliceous ore, and that from California mainly copper ore and dry and siliceous ore.

The value of the gold and silver recovered from 55,977,200 tons of base ores in 1927 was $37,302,622, an average of 67 cents a ton, of which about 18 cents represents gold. The average recovery from dry and siliceous ore in 1927 was $2.81 in gold a ton, so that a ton of such ore yielded fifteen and six-tenths times as much gold as the average derived from a ton of ore of all other classes combined and eighteen and seven-tenths times as much as was derived from a ton of copper ore which constituted more than 77 per cent of the total quantity of ores containing gold and silver in 1927. For this reason any large increase in the production of gold in the United States can not be expected even if the output of base ores should be doubled. The total yield of gold from base ores in 1927 exceeded that in 1926 by about $290,000; this increase was due largely to the higher yield from lead-zinc ore.

In 1927 the lead ore of Utah showed an average recovery in gold and silver of $13.33 a ton and that of Idaho, which produced 65 per cent of the total output of lead ore containing gold, only $2.46 a ton. In the output of ore considered as producing gold and silver the proportion of dry and siliceous ore decreased from 13.29 to 13.25 per cent, that of lead ore increased from 3.08 to 3.11 per cent, and that of copper ore decreased from 77.62 to 77.43 per cent. The proportion of all other classes of ore combined increased from 6.01 per cent of the total in 1926 to 6.21 per cent in 1927. These figures show little change in the relative proportion of the various classes of ore treated in 1927. The increases in the quantity of zinc ore and copper-lead ore compensated for the decrease in lead-zinc ore.

During the period 1906 to 1927 the peak of production of dry and siliceous ore was reached in 1916, although the proportion of such ores to the total was largest in 1906. The extraction value of these ores has varied considerably, depending to a large degree on the quantity of low-grade ores milled in Alaska and South Dakota. In 1927 Alaska produced more than half of the dry and siliceous ore treated, and Alaska and South Dakota together produced 67 per cent of the total. The average recovery of gold and silver from dry and siliceous ore has steadily decreased from $6.98 a ton in 1922 to $3.59 in 1927.

The decided decrease in the average extraction value of gold and silver in copper ore—from $1.55 a ton in 1906 to 32 cents in 1927—was caused by the low gold and silver content of the much increased quantity of copper ore from Arizona, New Mexico, Nevada, and Utah. As silver predominates over gold in nearly all lead ore and the total value of the silver from the lead ore is about 10 times that of the gold, the average extraction value shows a wider range than the quantity of ore. The recovery of gold and silver from lead ore in 1927—$4.89 a ton—was the lowest since 1915 and was only about one-half of that in 1919. Zinc ore constituted less than 1 per cent of the total ore shown in the following table, and its average extraction value showed a wide range. The lead-zinc ore yielded an average of only 53 cents a ton in gold but more than 4 ounces of silver. The copper-lead and copper-lead-zinc ores have been steadily increasing in quantity since 1921; the total produced in 1927 was an increase 48 per cent over 1926.

Ore produced in the United States and average extraction value of gold and silver per ton in 1927, by States[1]

State	Dry and siliceous ore		Copper ore		Lead ore		Zinc ore		Copper-lead and copper-lead-zinc ores		Lead-zinc ore		Total (short tons)
	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value	
Alaska	4,352,000	$0.69	645,000	$0.46									4,997,000
Arizona	151,701	5.87	21,677,976	.30	137,195	$3.89	1,320	$2.07	11,930	$3.97	11,752	$0.80	21,991,874
California	619,122	9.79	854,084	.66	14,066	3.41	24,266	1.95	193	17.34	14,679	1.01	1,526,410
Colorado	1,035,305	6.01	467	24.30	61,275	3.11	[2]392		410	15.87	508,679	1.78	1,606,528
Idaho	5,268	21.45	27,742	1.61	1,308,987	2.46			40,125	15.26	636,203	1.92	2,018,325
Michigan			[3]92,946	.59									92,946
Montana	111,976	5.56	2,958,445	1.38	57,182	3.67	332,404	2.82	263,868	1.23	498,732	2.53	4,222,607
Nevada	515,825	7.55	4,885,052	.22	75,924	12.19	[2]1,465		25,304	6.63	27,582	2.43	5,531,152
New Mexico	31,692	2.75	3,124,447	.12	10,678	3.12	57,336	.01	2,893	2.67	215,138	2.82	3,442,184
Oregon	10,625	11.63	16,214	1.33									26,839
Pennsylvania			[4]1,132,010	[4]2.12									1,132,010
South Dakota	1,376,583	4.88											1,376,583
Tennessee			630,955	.09			(2)						630,955
Texas	50,719	11.73			40	2.28							50,759
Utah	245,344	7.87	13,879,173	.20	337,734	13.33			73,878	1.58	1,220,945	4.34	15,757,074
Vermont			4,363	.11									4,363
Washington	13,450	10.71	37,564	.62	1,648	.76	35,307	.04			1,232	.07	119,201
Wyoming	110	10.94											110
	8,519,720	3.59	49,966,438	.32	2,004,729	4.89	452,490	2.18	418,601	3.07	3,134,942	2.99	64,526,920
Percentage	13.20		77.43		3.11		0.70		0.65		4.86		100.00
1926: Total	8,743,386	4.03	51,051,058	.36	2,023,572	5.26	214,268	1.03	282,015	5.28	3,460,437	3.91	65,787,884
Percentage	13.29		77.62		3.08		0.32		0.43		5.26		100.00

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[1] Illinois, Missouri, and Philippine Islands excluded; quantity of crude ore containing gold and silver not known.

[2] Zinc ore yielded no gold or silver.

[3] Includes only copper ore that yielded silver.

[4] Ore is pyritiferous magnetite yielding 3,168 tons of low-grade copper concentrates; value given is per ton of concentrate.

Ore produced in the United States and average extraction value of gold and silver per ton, 1918–1927[1]

Year	Dry and siliceous ore		Copper ore		Lead ore	
	Short tons	Average value	Short tons	Average value	Short tons	Average value
1918	9,702,240	$6.58	53,409,729	$0.50	2,356,585	$8.24
1919	9,302,229	6.25	29,919,369	.61	1,815,243	9.33
1920	8,590,139	6.26	32,447,410	.52	2,368,619	8.26
1921	8,436,214	6.65	10,930,888	.54	2,053,575	7.89
1922	8,728,222	6.98	23,356,128	.56	2,123,673	8.24
1923	9,121,719	5.91	41,596,309	.42	2,287,494	7.56
1924	8,979,113	5.21	44,887,379	.39	2,358,602	5.71
1925	8,994,910	4.57	47,186,114	.42	2,271,077	6.20
1926	8,743,386	4.03	51,064,058	.36	2,023,572	5.26
1927	8,549,720	3.59	49,966,438	.32	2,004,729	4.89

Year	Zinc ore		Copper-lead and copper-lead-zinc ores		Lead-zinc ore		Total (short tons)
	Short tons	Average value	Short tons	Average value	Short tons	Average value	
1918	210,298	$0.76	15,698	$16.19	2,352,350	$3.47	68,046,900
1919	88,654	.52	17,632	15.97	1,365,945	4.91	42,509,072
1920	482,229	3.00	26,890	30.01	1,443,904	4.10	45,359,191
1921	10,116	.76	14,248	31.76	122,287	16.96	21,567,328
1922	471,172	3.68	52,370	13.76	444,845	7.89	35,176,410
1923	723,994	2.55	162,181	7.30	1,203,698	3.39	55,095,395
1924	145,858	.14	219,874	3.83	1,791,852	3.14	58,382,678
1925	169,432	.79	228,612	3.44	2,703,471	3.37	61,553,616
1926	214,366	1.03	282,015	3.38	3,460,467	3.01	65,787,864
1927	452,490	2.18	418,601	3.07	3,134,942	2.99	64,526,920

[1] Arkansas, Illinois, Missouri, Philippine Islands, and Porto Rico excluded; quantity of crude ore containing gold and silver not known.

MINE PRODUCTION OF GOLD, BY SOURCES

As shown in the following table, 76.58 per cent of the domestic output of gold in 1927 was obtained from dry and siliceous ores—normally gold quartz and gold-silver quartzose ores—and from placers, compared with 78.53 per cent in 1926. The total contribution of gold from the great copper, lead, and zinc mines of the country is relatively small, notwithstanding their enormous development and production of ore.

Mine production of gold in the United States in 1927, by States, in fine ounces[1]

State or Territory	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
Alaska	144, 254. 25	142, 464. 37						286, 718. 62
Arizona	302. 68	30, 418. 12	159, 843. 83	9, 090. 83	10. 40	725. 31	103. 42	200, 494. 59
California	282, 380. 02	264, 913. 46	16, 556. 80	330. 46	335. 68	69. 08		564, 585. 50
Colorado	4, 568. 25	234, 669. 50	140. 61	2, 495. 90		87. 61	13, 415. 46	255, 377. 33
Georgia	50. 41							50. 41
Idaho	7, 520. 33	4, 823. 28	794. 38	1, 828. 47		1. 12	348. 09	15, 315. 67
Montana	1, 079. 97	18, 389. 30	27, 241. 47	1, 540. 90	1, 208. 51	314. 92	3, 766. 18	53, 541. 25
Nevada	1, 809. 22	94, 707. 50	46, 883. 96	6, 214. 20		416. 89	314. 39	150, 346. 16
New Mexico	280. 97	2, 516. 21	14, 442. 62	127. 07	2. 40		11, 872. 60	29, 241. 87
North Carolina	49. 10							49. 10
Oregon	8, 886. 36	4, 977. 88	811. 92					14, 676. 16
Pennsylvania[2]			299. 98					299. 98
South Dakota	14. 46	322, 017. 28						322, 031. 74
Tennessee			426. 47					426. 47
Texas		396. 29						396. 29
Utah		22, 709. 99	100, 057. 71	19, 868. 69		1, 016. 36	50, 256. 07	193, 908. 82
Washington	18. 82	19, 342. 20	139. 00	7. 26	6. 23			19, 513. 51
Wyoming		58. 05						58. 05
	451, 214. 84	1, 162, 403. 43	367, 638. 75	41, 503. 78	1, 563. 22	2, 631. 29	80, 076. 21	2, 107, 031. 52
Value	$9, 327, 439	$24, 029, 012	$7, 599, 768	$857, 958	$32, 314	$54, 394	$1, 655, 322	$43, 556, 207
Percentage	21. 41	55. 17	17. 45	1. 97	0. 07	0. 13	3. 80	100. 00
1926: Total	457, 716. 67	1, 295, 570. 01	365, 223. 35	45, 723. 55	1, 193. 70	3, 335. 50	63, 763. 21	2, 232, 525. 99
Value	$9, 461, 843	$26, 781, 809	$7, 549, 837	$945, 190	$24, 676	$68, 951	$1, 318, 102	$46, 150, 408
Percentage	20. 50	58. 03	16. 36	2. 05	0. 05	0. 15	2. 86	100. 00

[1] Philippine Islands excluded.

[2] From pyritiferous magnetite ore.

During the period 1918 to 1927 dry and siliceous ores yielded 63 per cent of the total output of gold; placer mining, 23 per cent; copper ore, 10 per cent; and all other ores, 4 per cent. It is evident that there can be no great increase from the miscellaneous base ores. The yield from copper ore may continue to increase, but probably not in great amount. The yield of gold from placers in 1927 was less than half that of the average of the years 1906 to 1916, and although there may be spasmodic increases during the next few years, it is certain that the output from this source will decline because of the steady exhaustion of ground capable of being worked with dredges. The new dredges operating in Alaska will probably compensate in part for a smaller production of gold from California dredges in the next few years. On the whole, the normal output from dredges will likely decrease, as will the output from hydraulicking and sluicing. Apparently any large increase in the yield of gold must come from dry and siliceous ores, which have yielded nearly two-thirds of the output in the last 23 years. As no new large bodies of dry and siliceous ore have been discovered and the grade of the ore treated has steadily decreased, there is apparently no reason to expect that the annual yield of gold from mines in the United States will exceed $45,000,000 to $50,000,000, and it may be considerably less.

Gold produced in the United States, by sources, as reported by mines, 1918–1927, in fine ounces[1]

Year	Placers	Dry and siliceous ores	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1918	758, 202	2, 045, 495	309, 018	55, 246	1, 188	1, 431	42, 093	3, 212, 673
1919	704, 377	1, 780, 567	186, 701	41, 945	86	1, 043	38, 563	2, 753, 282
1920	603, 002	1, 523, 331	171, 055	46, 776	3, 657	3, 731	31, 435	2, 382, 987
1921	677, 435	1, 548, 251	52, 765	61, 924	76	159	4, 400	2, 345, 010
1922	537, 910	1, 560, 789	130, 928	35, 415	2, 807	2, 467	22, 935	2, 293, 251
1923	551, 929	1, 510, 098	271, 690	38, 109	3, 321	3, 801	25, 965	2, 404, 913
1924	450, 720	1, 602, 469	310, 413	39, 947	227	1, 995	38, 560	2, 444, 331
1925	436, 251	1, 414, 446	348, 025	50, 378	375	5, 515	52, 384	2, 307, 374
1926	457, 717	1, 295, 570	365, 223	45, 724	1, 194	3, 335	63, 763	2, 232, 526
1927	451, 215	1, 162, 401	367, 639	41, 504	1, 563	2, 631	80, 076	2, 107, 032

[1] Philippine Islands and Porto Rico excluded.

PLACERS

General features.—The output of gold from placer mines in the United States (Philippine Islands excluded) in 1927 was 451,215 ounces, compared with 457,717 ounces in 1926. The States showing the largest increases were California (29,456 ounces), Oregon (2,948 ounces), and Colorado (2,297 ounces). Alaska showed the largest decrease (38,071 ounces), followed in order by Washington (1,336 ounces), Nevada (1,057 ounces), and Idaho (840 ounces). The placer gold is derived chiefly from dredging (which yielded 81 per cent of the total in 1927), from placers operated by hydraulicking, and from those washed or worked by drift mining and by sluicing. The last two methods are now relatively unimportant except in Alaska and California. There is also a small annual output of gold from dry placers in California, Arizona, and New Mexico and of gold and platinum from ocean-beach mining in California and Oregon, but these two sources are insignificant as producers of gold.

Dredging.—The value of gold recovered by dredges in the United States from the commercial inception of the industry in 1896 to the end of 1927 has amounted, according to the most authentic data available, to $218,634,877, of which $155,533,771 came from California, $33, 890,474 from Alaska, $9,592,435 from Montana, $8,050,905 from Colorado, $5,893,514 from Idaho, $5,046,644 from Oregon, and $627,134 from other States.

The output of gold from dredges in 1927 was $7,515,590, compared with $7,522,785 in 1926; the number of dredges operated in 1927 was 59, compared with 63 in 1926. Of the total for 1927, California produced $5,461,929 from 25 dredges, Alaska $1,740,000 from 28 dredges, Idaho $114,116 from 3 dredges, Oregon $112,643 from 2 dredges, and Colorado $86,902 from 1 dredge. In addition, dredges operated in the Philippine Islands in 1927 produced about $51,400 in gold.

Gold produced in the United States by dredges, 1918–1927

Year	Dredges	California	Alaska	Other States [1]	Total
1918	93	$7, 431, 927	$1, 425, 000	$1, 485, 173	$10, 342, 100
1919	91	7, 716, 919	1, 360, 000	1, 269, 297	10, 346, 216
1920	78	6, 900, 366	1, 129, 932	1, 256, 158	9, 286, 456
1921	72	7, 756, 787	1, 582, 520	1, 196, 261	10, 535, 568
1922	71	4, 999, 215	1, 767, 753	922, 300	7, 689, 268
1923	66	6, 065, 735	1, 848, 596	1, 084, 716	8, 999, 047
1924	63	4, 305, 521	1, 563, 361	1, 044, 099	6, 912, 981
1925	60	4, 750, 842	1, 572, 312	507, 874	6, 831, 028
1926	63	4, 950, 545	2, 291, 000	281, 240	7, 522, 785
1927	59	5, 461, 929	1, 740, 000	313, 661	7, 515, 590

[1] Colorado, Idaho, Montana, Nevada, and Oregon.

Further information on this subject may be found in previous issues of Mineral Resources, in reports of the Director of the Mint, and in reports of geological surveys or mining officials of the various States.

DRY AND SILICEOUS ORES

The siliceous ore comprises free-milling (amalgamating) ore, as in Alaska, California, and Oregon; both amalgamating and concentrating ore, as in many States; simply concentrating ore, as in parts of Colorado and Arizona; all-sliming and cyaniding ore, as in Nevada; and finally smelting ore. Tailings both from old dumps and from current millings are largely reworked by concentration and subsequent cyanidation or smelting. The material smelted consists mainly of concentrates and of siliceous and pyritic ores, which are also valuable as fluxes. Figures of relative output by methods and by States are given on page 631.

As most of the gold produced in the United States is derived from placer gravel and dry and siliceous ores, including true gold, gold-silver, and silver ores, the following table for certain States is of special interest.

Gold produced in six Western States, 1923–1927

State and year	Total (lode and placer)			Gold ore				Gold-silver ore		Silver ore		Placer	
	Mines producing	Ore mined (short tons)	Gold (fine ounces)	Mines producing	Short tons	Gold (fine ounces)		Short tons	Gold (fine ounces)	Short tons	Gold (fine ounces)	Mines producing	Gold (fine ounces)
						Total	Average						
Arizona:													
1923	341	17,015,178	296,109.23	65	226,585	142,442.85	0.63	268,537	35,273.99	71,171	6,742.02	24	428.31
1924	275	19,820,505	235,995.74	65	209,356	92,771.09	.44	8,291	4,857.81	22,108	3,001.16	9	151.85
1925	386	20,927,382	201,740.92	77	71,289	33,644.79	.47	2,036	432.77	51,665	2,886.27	18	206.42
1926	383	22,382,685	234,010.97	74	111,083	47,586.24	.43	9,440	1,713.32	19,426	1,385.74	21	338.96
1927	308	21,991,874	200,494.59	77	122,153	27,032.05	.22	11,074	2,090.88	18,474	1,295.19	15	302.68
Idaho:													
1923	231	1,763,520	37,124.28	47	21,953	6,247.99	.28	311	82.91	1,795	239.24	85	24,125.05
1924	220	1,711,988	26,921.80	39	17,886	5,646.12	.32	17	30.86	1,357	131.45	79	17,324.10
1925	275	1,827,715	20,886.92	50	13,853	3,678.39	.27	434	317.89	3,848	58.25	85	12,692.92
1926	246	1,934,143	13,669.27	41	5,124	2,811.27	.55	44	107.85	694	76.05	69	8,360.45
1927	218	2,018,325	15,315.67	41	4,389	4,622.17	1.05	37	141.57	842	59.54	70	7,520.33
Montana:													
1923	382	5,743,535	85,079.43	78	217,307	48,277.86	.22	275	394.11	124,671	6,071.84	78	1,972.68
1924	388	4,652,482	97,854.16	110	154,942	57,701.18	.37	161	133.32	52,384	5,339.76	86	1,323.59
1925	424	4,405,008	82,122.85	98	149,721	34,351.64	.23	1,209	276.45	43,761	3,453.34	93	1,905.25
1926	393	4,470,055	60,504.11	101	80,847	21,583.35	.27	1,415	482.70	11,309	1,744.02	58	1,104.30
1927	307	4,222,607	53,541.25	79	50,764	16,467.40	.32	170	138.94	61,042	1,782.96	60	1,079.97
Nevada:													
1923	389	4,354,937	204,292.89	128	142,148	64,197.59	.45	551,504	39,417.45	678,318	63,579.46	35	3,941.83
1924	384	4,699,333	217,962.56	152	139,041	70,067.65	.50	524,248	48,099.53	403,190	63,460.37	36	1,323.97
1925	424	4,927,139	187,104.72	156	129,914	59,519.79	.46	424,077	46,224.28	290,957	35,134.18	25	2,536.54
1926	405	5,884,568	175,381.68	139	141,967	51,699.25	.36	433,749	50,090.77	230,802	24,825.08	28	2,866.17
1927	409	5,531,152	150,346.16	158	294,308	66,615.25	.23	5,269	1,268.99	216,248	26,823.26	30	1,809.22
Utah:													
1923	150	12,752,998	148,824.86	9	17,903	9,333.57	.52	23,722	3,095.32	304,800	20,285.62	4	25.49
1924	138	13,640,618	146,486.85	8	2,129	2,268.12	1.07	39,490	11,287.00	240,607	13,543.63	2	11.22
1925	179	14,479,247	177,803.08	8	8,087	2,411.08	.30	119,337	22,081.90	261,606	9,776.84	----------	----------
1926	166	15,856,144	182,762.98	7	344	1,297.40	3.77	113,476	14,165.75	187,393	8,633.93	2	16.16
1927	123	15,757,074	193,908.82	7	4,226	3,390.88	.80	83,004	7,667.38	158,114	11,651.73	----------	----------
Washington:													
1923	36	56,900	16,547.49	12	30,146	16,310.46	.54	----------	----------	3,353	38.46	6	73.09
1924	34	44,383	14,977.72	12	17,543	14,705.87	.84	----------	----------	32	.28	4	33.77
1925	46	50,287	11,138.49	8	15,376	10,870.47	.71	----------	----------	7	5.72	9	52.87
1926	58	54,343	9,340.82	9	17,599	7,707.83	.44	----------	----------	----------	----------	9	1,354.50
1927	33	119,201	19,513.51	11	43,442	19,342.06	.45	----------	----------	8	.14	3	18.82

Nearly all the siliceous ore in three of the largest gold-producing States—Alaska, California, and South Dakota—yields only a small quantity of silver and is classed as gold ore. The siliceous ore from Colorado includes much silver and gold-silver ore.

Siliceous ore treated and gold recovered per ton of ore treated, 1918–1927

Year	Alaska		California		South Dakota		Colorado	
	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton
	Short tons	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*
1918	2, 095, 577	0. 080	1, 538, 960	0. 261	1, 781, 569	0. 178	1, 760, 222	0. 322
1919	3, 262, 573	. 068	1, 212, 142	. 339	1, 330, 349	. 177	1, 667, 076	. 258
1920	3, 413, 736	. 063	788, 136	. 439	1, 356, 098	. 167	1, 224, 081	. 257
1921	2, 894, 813	. 064	902, 566	. 402	1, 725, 669	. 185	1, 230, 172	. 250
1922	2, 513, 455	. 058	1, 052, 148	. 414	1, 751, 454	. 180	1, 296, 501	. 221
1923	2, 502, 901	. 045	925, 659	. 347	1, 665, 439	. 186	1, 166, 470	. 243
1924	3, 127, 876	. 042	1, 075, 858	. 364	1, 674, 720	. 177	1, 074, 876	. 344
1925	3, 573, 540	. 042	886, 625	. 413	1, 590, 079	. 182	1, 187, 054	. 271
1926	3, 924, 925	. 036	717, 326	. 433	1, 415, 785	. 197	1, 240, 195	. 259
1927	4, 352, 000	. 033	619, 122	. 428	1, 376, 583	. 234	1, 035, 305	. 227

The quantity of siliceous ore treated in South Dakota in 1927 was slightly less than in 1926, but the recovery of gold per ton was 76 cents more; the quantity of siliceous ore from California was nearly 100,000 tons less, and the recovery of gold per ton was 10 cents less; the quantity of siliceous ore treated in Alaska was 427,000 tons more, but the recovery of gold per ton was the lowest ever recorded; and the quantity of siliceous ore treated in Colorado was 205,000 tons less, and the recovery of gold per ton was 66 cents less. These four States yielded 86 per cent of the total dry and siliceous ore treated in 1927 and 83 per cent of the total gold from such ores.

COPPER ORE

The gold obtained as a by-product in the treatment of copper ore showed an increase in 1927 of about $50,000, following an increase of $355,500 in 1926. Copper ore yielded a larger percentage of the total gold than in 1926, although the quantity of ore treated decreased 2 per cent. The largest producer of gold from copper ore in 1927 was Arizona with 43.5 per cent of the total, followed by Utah, Nevada, Montana, California, and New Mexico.

LEAD ORE

The production of gold from lead ore showed a decrease of 9 per cent compared with the output in 1926, and about 70 per cent of the total came from Utah and Arizona.

LEAD-ZINC, ZINC, AND MIXED ORES

The production of gold from zinc, lead-zinc, copper-lead, and copper-lead-zinc ores in 1927 increased 23 per cent, compared with that of 1926. Utah, Colorado, and New Mexico produced nearly all the gold from lead-zinc ore, Montana and California produced most of the gold from zinc ore, and Utah and Arizona produced two-thirds of the gold from copper-lead and copper-lead-zinc ores.

MINE PRODUCTION OF SILVER, BY SOURCES

The mine production of silver in 1927 from the chief sources—lead ore, copper ore, lead-zinc ore, and siliceous ore—was 93 per cent of the total, compared with 97 per cent from the same classes of ore in 1926; the only gain was from lead ore. The combined yield of silver from placer bullion, zinc ore, and other mixed ores was 7 per cent of the total, compared with 3 per cent in 1926; all the gain was from the ores. The production of silver in 1927, as reported by the mines, was 59,625,682 fine ounces—the smallest output since 1921 and nearly 25 per cent less than that in the record year 1916. The combined output from lead and lead-zinc ores decreased from 30,101,870 ounces in 1926 to 29,386,341 ounces in 1927. The recovery from siliceous ore decreased about 1,791,700 ounces and was the smallest annual recovery in more than a score of years, being nearly 60 per cent less than that in the record year 1922. The recovery from copper ore decreased about 2,483,000 ounces. The total recovery of silver from base ores in 1927 was about 1,069,800 ounces less than in 1926.

Mine production of silver in the United States in 1927, by States, in fine ounces[1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
Alaska	23,300	79,400	525,100					627,800
Arizona	43	461,321	5,702,270	609,718	4,434	57,036	12,858	6,847,680
California	20,903	1,032,589	393,533	72,644	71,074	3,383	26,116	1,620,242
Colorado	1,136	2,409,501	14,888	244,788		8,284	1,106,008	3,784,605
Georgia	7							7
Idaho	2,306	23,420	49,623	5,609,605		1,079,747	2,136,708	8,901,409
Illinois[2]				1,518				1,518
Michigan			97,193					97,193
Missouri				233,931				233,931
Montana	197	427,105	6,201,827	314,100	1,607,188	559,918	2,089,742	11,200,077
Nevada	740	3,419,940	183,525	1,405,418		280,713	106,843	5,397,179
New Mexico	32	61,810	122,093	54,104	934	13,600	637,510	890,083
North Carolina	5							5
Oregon	1,155	36,376	8,299					45,830
Pennsylvania[3]			2,000					2,000
South Dakota		96,171						96,171
Tennessee			81,460					81,460
Texas		1,034,705		161				1,034,866
Utah		2,577,357	1,138,014	7,214,271		169,111	7,508,197	18,606,950
Vermont			821					821
Washington	5	115,684	35,926	1,939	2,134		162	155,850
Wyoming		5						5
	49,829	11,775,384	14,556,572	15,762,197	1,685,764	2,171,792	13,624,144	59,625,682
Value	$28,253	$6,676,643	$8,253,576	$8,937,166	$955,828	$1,231,406	$7,724,890	$33,807,762
Percentage	0.08	19.75	24.41	26.44	2.83	3.64	22.85	100.00
1926: Total	49,890	13,567,095	17,039,546	15,528,454	313,119	1,415,699	14,573,416	62,487,219
Value	$31,131	$8,465,867	$10,632,677	$9,689,755	$195,386	$883,396	$9,093,812	$38,992,024
Percentage	0.08	21.71	27.27	24.85	0.50	2.27	23.32	100.00

[1] Philippine Islands excluded.

[2] From fluorspar-lead ores.

[3] From pyritiferous magnetite ore.

Silver produced in the United States, by sources, as reported by mines, 1918–1927, in fine ounces[1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1918	89, 494	21, 564, 982	20, 462, 597	18, 291, 243	135, 676	224, 580	7, 290, 380	68, 058, 952
1919	78, 401	19, 043, 515	12, 880, 624	14, 351, 293	39, 480	232, 157	5, 273, 990	51, 899, 460
1920	73, 383	20, 477, 612	12, 151, 424	17, 069, 506	1, 258, 341	669, 503	4, 837, 135	56, 536, 904
1921	81, 375	24, 117, 251	4, 782, 538	14, 912, 990	6, 163	449, 417	1, 983, 222	46, 332, 956
1922	60, 769	28, 631, 579	10, 376, 123	16, 756, 835	1, 676, 967	669, 809	3, 035, 907	61, 207, 989
1923	57, 752	27, 636, 947	14, 684, 333	20, 139, 928	2, 171, 186	1, 348, 025	4, 317, 503	70, 355, 674
1924	51, 251	20, 388, 065	16, 335, 433	18, 858, 782	24, 431	1, 194, 323	7, 218, 459	64, 070, 744
1925	50, 303	17, 099, 876	18, 051, 937	18, 777, 853	181, 886	970, 370	11, 577, 855	66, 710, 080
1926	49, 890	13, 567, 095	17, 039, 546	15, 528, 454	313, 119	1, 415, 699	14, 573, 416	62, 487, 219
1927	49, 829	11, 775, 384	14, 556, 572	15, 762, 197	1, 685, 764	2, 171, 792	13, 624, 144	59, 625, 682

[1] Philippine Islands and Porto Rico excluded.

PLACERS

The output of silver from the refining of placer gold in 1927 was 61 ounces less than in 1926. Of the total production 89 per cent came from Alaska and California. The bullion from placers in Nevada contained the largest percentage of silver and that from California the smallest.

DRY AND SILICEOUS ORES

About 29 per cent of the mine production of silver from dry and siliceous ore came from Nevada (mainly from the Tonopah district), 22 per cent from Utah (mainly from the Tintic district), and 20 per cent from Colorado. The only large increases in the quantity of silver from siliceous ore were in Montana, Texas, and Washington, and the large decreases were in California, Colorado, Nevada, New Mexico, and Utah.

A large part of the silver from gold-silver siliceous ore is obtained with the gold by amalgamation and cyanidation in the mills. Very little of the gold and silver ores is treated by flotation, which is so extensively used on base ores, and no estimate is available for the quantity so treated in 1927. The remainder of the silver is recovered by smelting the richer ore and refining the base bullion.

COPPER ORE

The silver produced from copper ore is nearly all obtained in the electrolytic refining of Lake and blister copper. The copper ore is mainly sulphide (except the Lake ore of Michigan, which consists of native metal in amygdaloid and conglomerate matrix), and a greater quantity contains chalcocite than chalcopyrite or cupriferous pyrite. The silver tenor of much of the copper ore, especially that of the

Santa Rita district, New Mexico, and of Ely, Nev., is notably low, but other regions yield copper ore that contains considerable quantities of silver.

In output of silver from copper ore Montana continued to lead, with a yield of 6,201,827 ounces in 1927, compared with 7,762,190 ounces in 1926; Arizona was again second, with 5,702,270 ounces in 1927, compared with 5,984,415 ounces in 1926; and Utah was again third, with 1,138,014 ounces in 1927, compared with 1,281,767 ounces in 1926. These three States yielded nearly 90 per cent of the silver from copper ore in 1927. The production of Montana comes mainly from Butte, that of Arizona mainly from Bisbee and Jerome, that of Utah mainly from Bingham, and that of California mainly from Plumas County. Of these districts Bisbee well represents the disseminated type, Bingham produces from both lode and disseminated deposits, and the remainder produce silver chiefly from copper ore mined from deep lodes. Some silver is also produced in leaching copper ore.

LEAD ORE

The mine production of silver from argentiferous lead ore in 1927 was about 233,700 ounces more than in 1926. The largest increases were as follows: Idaho, 1,034,100 ounces, and Missouri, 143,900 ounces. The largest decreases were as follows: Colorado, 382,200 ounces; Montana, 200,500 ounces; and Arizona, 107,200 ounces. Most of the output is obtained from the desilverization of lead bullion from the smelting of western concentrates. The largest producers of silver-lead ore are the mines in the Coeur d'Alene region in Idaho and the Park City and Tintic districts in Utah.

ZINC, LEAD-ZINC, AND MIXED ORES

The mine production of silver from argentiferous zinc ore increased from 313,119 ounces in 1926 to 1,685,764 ounces in 1927; it was mainly from residues of zinc concentrates from Montana shipped to smelters. The output of silver from lead-zinc ore decreased from 14,573,416 ounces in 1926 to 13,624,144 ounces in 1927; it came chiefly in 1927 from Utah, Idaho, Montana, Colorado, and New Mexico. Silver from copper-lead and copper-lead-zinc ores in 1927 came mainly from Idaho, Montana, Nevada, Utah, and Arizona, and the quantity increased from 1,415,699 ounces in 1926 to 2,171,792 ounces in 1927.

DISTRIBUTION OF PRODUCTION OF GOLD AND SILVER, BY METHODS OF TREATMENT

SUMMARY OF DISTRIBUTION

The following table gives the production of gold and silver from ore, old tailings, etc., treated in 1926 and 1927.

Gold and silver produced in the United States from ore, old tailings, etc., in 1927, by States and by methods of recovery

State or Territory	Total quantity of crude ore, old tailings, etc., treated (short tons)	Ore, old tailings, etc., to gold and silver mills				Ore and old tailings to concentrating mills (short tons)	Concentrates from all sources			Crude ore to smelters			Ore leached, old tailings and slag smelted, etc.		
		Ore (short tons)	Old tailings, etc. (short tons)	Gold in bullion (fine ounces)	Silver in bullion (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Alaska	4, 997, 000	4, 342, 500	--------	[2] 113, 253	[2] 18, 313	639, 236	73, 049	29, 211	361, 818	15, 264	--------	224, 369	--------	--------	--------
Arizona	21, 991, 874	104, 145	515	23, 118	41, 440	15, 119, 697	917, 593	51, 512	1, 828, 311	2, 613, 934	124, 371	4, 919, 954	4, 153, 583	1, 191	57, 932
California	1, 526, 410	[3] 578, 629	3, 640	[4] 241, 430	[4] 196, 155	814, 639	61, 483	36, 737	1, 218, 909	58, 998	3, 590	164, 078	70, 504	449	20, 197
Colorado	1, 606, 528	774, 162	(5)	191, 317	123, 241	726, 969	172, 569	49, 313	2, 920, 211	105, 397	10, 179	740, 017	--------	--------	--------
Idaho	2, 018, 325	4, 323	30	3, 791	1, 748	1, 940, 210	313, 047	2, 861	7, 459, 724	73, 762	1, 143	1, 437, 631	--------	--------	--------
Montana	4, 222, 607	33, 936	1, 063	9, 674	30, 372	4, 014, 106	912, 540	35, 246	10, 466, 583	124, 441	7, 271	608, 722	49, 061	270	94, 203
Nevada	5, 531, 152	322, 530	140, 060	75, 727	3, 029, 100	4, 868, 035	327, 003	47, 624	1, 487, 627	199, 077	25, 004	870, 906	1, 450	182	8, 806
New Mexico	3, 442, 184	6, 408	--------	1, 481	545	3, 255, 612	248, 487	16, 617	656, 690	180, 164	10, 863	232, 816	--------	--------	--------
Oregon	26, 839	3, 260	(6)	[7] 1, 593	[7] 354	23, 162	1, 775	3, 617	39, 486	292	475	4, 374	125	105	461
South Dakota	1, 376, 583	1, 371, 583	(8)	322, 010	93, 485	5, 000	199	7	2, 686	--------	--------	--------	--------	--------	--------
Texas	50, 759	48, 190	--------	317	788, 369	--------	765	79	216, 015	2, 569	--------	30, 482	--------	--------	--------
Utah	15, 757, 074	10	--------	4	--------	15, 103, 376	836, 931	140, 505	8, 480, 673	530, 545	44, 818	9, 665, 925	[9] 123, 143	8, 582	460, 352
Washington	119, 201	6, 468	--------	4, 211	222	74, 412	4, 401	141	19, 939	38, 321	15, 143	135, 684	--------	--------	--------
Wyoming	110	110	--------	58	5	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Eastern States	[10] 1, 767, 328	--------	--------	--------	--------	[11] 1, 471, 355	[11] 43, 916	530	49, 749	[11] 295, 973	196	34, 532	--------	--------	--------
	64, 433, 974	7, 596, 254	145, 308	987, 984	4, 323, 349	48, 055, 809	3, 913, 758	414, 000	35, 208, 421	4, 238, 737	243, 053	19, 069, 490	4, 397, 866	10, 779	641, 951
Total, 1926	65, 693, 857	7, 938, 843	9, 945	1, 098, 206	5, 314, 471	51, 198, 166	4, 798, 164	401, 908	34, 568, 267	4, 804, 664	256, 178	21, 152, 959	1, 742, 239	18, 519	1, 203, 400

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[1] Exclusive of gold or silver as follows: From copper ore in Michigan, from lead and lead-fluorspar ore in Illinois and Missouri, and from siliceous ore in Philippine Islands.

[2] Exclusive of bullion from 1,420 tons of concentrates amalgamated, figures for which are included under "Concentrates from all sources."

[3] Also 3,812 tons of concentrates from California were cyanided and yielded 12,215.34 ounces of gold and 3,419 ounces of silver. The figures are included under "Concentrates from all sources."

[4] Includes 12,235.36 ounces of gold and 2,440 ounces of silver from "high grade."

[5] Sands and slimes (301,321 tons) from ore and concentrates first treated by amalgamation were cyanided.

[6] Small quantity of tailings amalgamated.

[7] Includes 5 ounces of gold and 53 ounces of silver from tailings amalgamated.

[8] Sands and slimes (1,353,298 tons) from ore first treated by amalgamation were cyanided.

[9] Includes tailings treated in a volatilization plant.

[10] Includes low-grade pyritiferous magnetite ore from Pennsylvania; excludes ore containing no gold and silver.

[11] Includes only ore or concentrates that yielded gold and silver.

The greatest output of ore, etc., was made in Arizona, Utah, Nevada, Montana, and New Mexico, all notable for large yields of copper ore; in Idaho, a large producer of lead ore and lead-zinc ore; in Alaska and California, large producers of both copper and siliceous ores; and in South Dakota and Colorado, large producers of siliceous ore.

The only large increases in ore sent direct to gold and silver mills were in Alaska, Arizona, New Mexico, Texas, and Washington. Many gold and silver mills employ concentrating apparatus, and the concentrates they obtain are combined in the preceding table with those from straight concentrating mills under the heading "Concentrates from all sources." The gold and silver included in this item are recovered partly by amalgamation (particularly in Alaska) and cyanidation, although most of the concentrates are smelted.

The figures for the quantity of ore treated by concentration include the large quantities of copper, lead, zinc, and mixed ores whose concentrates are smelted primarily for these metals, the gold and silver being recovered in refining the copper and lead bullion and smelting the zinc residues. The quantity of concentrates produced and the recoverable gold and silver content represent not only the concentrates from these straight concentrating mills but also the comparatively small quantity from gold and silver mills.

Of the total quantity (48,055,809 tons) of ore sent direct to concentrating plants in the United States in 1927, Arizona and Utah each contributed more than 15,100,000 tons. Of the total gold recovered from concentrates, 70 per cent came from four States, as follows: Utah, 34 per cent; Arizona, Colorado, and Nevada, 12 per cent each. Of the silver from concentrates, 75 per cent came from Montana, Utah, and Idaho; large quantities also came from Colorado, Arizona, Nevada, and California. The decrease of 6 per cent in 1927 in the quantity of ore treated in straight concentration mills was due mainly to the smaller quantities milled in Arizona, California, Nevada, and New Mexico. Figures showing the quantity of gold-silver ore treated by flotation in 1927 are not available; ore so treated in 1926 amounted to 525,660 tons and yielded 28,428 tons of concentrates. The quantity of gold and silver recovered from flotation concentrates increased in 1927; only a small percentage of these concentrates resulted from the treatment of gold and silver ores as the greater number of flotation mills making concentrates containing gold and silver treat base ores.

The figures for the quantity and the recoverable precious-metal content of crude ore shipped from the mines direct to the smelters include, in general, the richer gold, silver, copper, lead, and mixed ores from which the gold and silver are eventually recovered by refining the copper or lead bullion that collects the precious metals in the smelting. There has been a large decrease in the last decade in the quantity of crude ore directly smelted and a large increase in the quantity of ore concentrated. In 1927 Arizona produced 62 per cent of the ore directly smelted, and Utah and Arizona produced 76 per cent of the silver and 70 per cent of the gold recovered from crude ore smelted.

The old materials, mainly tailings and slags, re-treated (with which are included figures for ore and old tailings leached) are partly smelted, often for their fluxing as well as their metal value; considerable quantities of old tailings were concentrated and cyanided in 1927, and the impounding of mill tailings for future treatment, as well as because of legal requirements, has become a general practice. Most of the gold and silver derived from old tailings is included under recoveries by amalgamation and cyanidation at gold and silver mills. In addition to ore mined and leached, ore was leached in place in Utah and Nevada, and the copper was recovered by precipitation. The leaching of old dumps in New Mexico was continued.

Gold and silver produced at mills in the United States and percentage of gold and silver recovered by smelting and from placers, 1918–1927 [1]

Year	Ore, old tailings, etc., treated (short tons)	Bullion recovered from all sources (fine ounces)					
		Amalgamation		Cyanidation		Chlorination	
		Gold	Silver	Gold	Silver	Gold	Silver
1918	8,524,496	678,359	216,670	1,047,186	9,726,605	5,770	3,631
1919	8,668,507	839,761	279,793	685,330	7,163,726		
1920	7,560,043	679,409	228,807	580,205	7,582,358		
1921	7,429,125	765,397	207,877	559,352	7,414,275		
1922	7,442,998	812,396	183,119	541,318	8,803,787		
1923	7,657,613	683,274	179,527	607,415	10,044,388		
1924	8,023,899	746,777	231,742	563,208	8,921,688		
1925	8,022,807	753,313	214,790	476,599	6,360,571		
1926	7,948,788	682,345	184,640	455,649	5,173,664		
1927	7,741,562	649,044	195,895	377,853	4,177,848		

Year	Percentage of gold and silver from all sources									
	Amalgamation		Cyanidation		Chlorination		Placers		Smelting [2]	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1918	20.7	0.3	32.0	14.3	0.2		23.6	0.13	23.5	85.3
1919	31.5	.5	28.5	13.8			25.6	.15	14.4	85.5
1920	28.5	.4	21.3	13.4			25.3	.13	21.9	86.1
1921	32.6	.45	23.9	16.0			28.9	.18	14.6	83.4
1922	35.4	.3	23.6	14.4			23.5	.1	17.5	85.2
1923	28.4	.3	25.3	14.3			22.9	.1	23.4	85.3
1924	30.6	.4	23.0	13.9			18.4	.1	28.0	85.6
1925	32.6	.3	20.7	9.5			18.9	.1	27.8	90.1
1926	30.6	.3	20.4	8.3			20.5	.1	28.5	91.3
1927	30.8	.3	17.9	7.0			21.4	.1	29.9	92.6

[1] Philippine Islands and Porto Rico excluded.

[2] Both crude ores and concentrates.

About 21 per cent of the total gold output in 1927 came from placers; the percentage of the output of silver credited to the placers was insignificant. Colorado and South Dakota ores yielded the larger part of the gold recovered by cyanidation; the decrease in total quantity of gold recovered by cyanidation was due mainly to the large declines in Arizona, California, Colorado, and Nevada. South Dakota was the only State to show an appreciable increase in gold recovered by cyanidation and by amalgamation. The largest decreases in gold recovered by amalgamation were in California, Colorado, Montana, and Nevada. The chlorination process has not been used in California since 1918.

GOLD AND SILVER PRODUCED AT MILLS, BY STATES

A large quantity of concentrates from sulphide ores is now smelted, and the increased application of the flotation process has resulted in decreased yield of gold and silver from cyanidation, as nearly all such concentrates are shipped to smelters. The smelters are credited in 1927 with 29.9 per cent of the total output of gold and 92.6 per cent of the silver, compared with 14.4 per cent of the gold and 85.5 per cent of the silver in 1919.

The bulk of the gold produced continues to come from the gold mills, although the proportion of gold so recovered in 1927 was only 48.7 per cent of the total, compared with 60 per cent in 1919.

Gold and silver bullion produced at mills in 1927, by States[1]

State or Territory	Ore, old tailings, etc., treated (short tons)	Bullion recovered from all sources (fine ounces)				Percentage of gold and silver from all sources in State			
		Amalgamation		Cyanidation		Amalgamation		Cyanidation	
		Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Alaska	[2]4,342,500	138,495	65,233	1,435	55	48.3	10.4	0.5	
Arizona	104,660	836	746	22,282	40,694	.4		11.1	0.6
California	[2]582,269	210,917	47,831	42,729	151,743	37.4	3.0	7.6	9.4
Colorado	[3]774,162	68,005	20,326	123,312	102,915	26.6	.5	48.3	2.7
Idaho	4,353	3,791	1,508	(4)	240	24.8			
Montana	34,999	3,968	2,488	5,706	27,884	7.4		10.7	.2
Nevada	462,590	6,733	4,157	68,994	3,024,943	4.5	.1	45.9	56.0
New Mexico	6,408	1,481	545			5.1	.1		
Oregon	[5]3,260	1,593	354			10.9	.8		
South Dakota	[6]1,371,583	208,952	52,480	113,058	41,005	64.9	54.6	35.1	42.6
Texas	48,190			317	788,369			80.1	76.2
Utah	10	4							
Washington	6,468	4,211	222			21.6	.1		
Wyoming	110	58	5			100.0	100.0		
	7,741,562	649,044	195,895	377,833	4,177,848	30.8	.3	17.9	7.0
Value		$13,416,930	$111,072	$7,810,501	$2,368,840				
1926:									
Total	7,948,788	682,345	184,640	455,640	5,173,664	30.6	.3	20.4	8.3
Value		$14,105,323	$115,215	$9,418,915	$3,228,366				

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[1] Philippine Islands excluded.

[2] Also concentrates treated in gold and silver mills; metal content included under "Bullion recovered from all sources." For details see p. 631.

[3] Also 301,321 tons of sands and slimes from ore and concentrates amalgamated were treated by cyanidation.

[4] 0.20 ounce.

[5] Also small quantity of tailings amalgamated; metal content included under "Bullion recovered from all sources." For details see p. 631.

[6] Also 1,353,298 tons of sands and slimes from ore amalgamated were treated by cyanidation.

The great bulk of the ore treated in gold and silver mills was from Alaska, South Dakota, Colorado, California, and Nevada, and here the famous mines and mills of the Homestake, Mother Lode, Grass Valley, Treadwell, Cripple Creek, Tonopah, and Goldfield districts are especially noteworthy. Large numbers of smaller mills, however, mark the wide distribution of gold mining in these regions and in many other scattered districts.

The total yield of gold by amalgamation in the United States in 1927 was 649,044 ounces, compared with 1,120,344 ounces in 1911, the first year for which figures are available. The only important increases in 1927 over 1926 were in Alaska, Idaho, New Mexico, South Dakota, and Washington; the largest decreases were as follows: California, 30,331 ounces; Colorado, 27,050 ounces; and Montana, 3,202 ounces.

The output of gold by cyanidation in 1927 was 377,833 ounces, compared with 1,444,077 ounces in 1915, the year of largest recorded output. The only increases in 1927 over 1926 were in Montana, South Dakota, and Texas; the principal decreases were as follows: Arizona, 15,485 ounces; California, 12,949 ounces; Colorado, 28,260 ounces; and Nevada, 40,131 ounces. Nevada continued to lead in yield of silver by cyanidation, producing 72 per cent of the total in 1927, but falling off 1,244,517 ounces in output compared with 1926; the only notable gains in 1927 were in Colorado and Texas.

Alaska, California, Idaho, New Mexico, Oregon, South Dakota, and Washington yielded more gold by amalgamation than by cyanidation, but cyanidation produced more gold than amalgamation in Arizona, Colorado, Montana, and Nevada, and it produced more silver in Arizona, California, Colorado, Montana, Nevada, and Texas. In Alaska, Idaho, New Mexico, Oregon, South Dakota, and Washington the recovery of silver by amalgamation exceeded that by cyanidation. In 1927 amalgamation produced gold and silver valued together at $13,528,002, compared with $10,179,341 produced by cyanidation.

QUICKSILVER AND POTASSIUM AND SODIUM CYANIDE USED

Figures showing the total quantities of quicksilver and cyanide used in the recovery of gold and silver in the United States in 1927 are not available. For details of the use of quicksilver in the amalgamation milling process and of potassium cyanide and sodium cyanide in the cyanidation process the reader is referred to the mine reports for the several Western States.

A considerable quantity of quicksilver was used at gold dredges in Alaska, California, Oregon, and other States, and the following quantities of quicksilver were purchased for use at gold and silver mills in the States for which figures are available: Arizona, 75 pounds; Colorado, 3,040 pounds; Idaho, 335 pounds; Montana, 295 pounds; Nevada, 605 pounds; New Mexico, 250 pounds; South Dakota, 14,188 pounds; Washington, 60 pounds.

Considerable cyanide is used at flotation mills as well as at gold and silver mills. Cyanide used at gold and silver mills in 1927 was mainly sodium cyanide; some cyanamid and a little potassium cyanide were also used. Reduced to the equivalent of 96 to 98 per cent NaCN, the use at mines in the States for which figures are available was as follows: Arizona, 92,815 pounds; Colorado, 270,000 pounds; Montana, 36,308 pounds; Nevada, 1,105,600 pounds; South Dakota, 312,626 pounds; Texas, 96,813 pounds. No cyanide was reported as consumed in New Mexico, Utah, Washington, or Wyoming.

The following table gives details of the use of cyanide in 10 of the Western States during the last five years.

Potassium and sodium cyanide consumed at mills in 10 Western States, 1923–1927

State and year	Number of mills using cyanidation process	Ore and old tailings treated (short tons)	Cyanide consumed (pounds)[1]		
			Total	Per ton of ore and old tailings	Per ounce of gold and silver
Arizona:					
1923	10	242,652	330,666	1.36	0.85
1924	7	146,904	135,971	.93	1.05
1925	6	59,840	84,600	1.41	1.66
1926	10	96,545	90,315	.94	1.03
1927	9	102,932	92,815	.90	1.47
Colorado:					
1923	3	383,595	309,565	.81	2.16
1924	3	451,366	306,196	.68	1.70
1925	2	463,922	309,293	.67	1.75
1926	3	508,060	258,327	.51	1.49
1927	2	501,011	270,000	.54	1.19
Idaho:					
1923	3	784	3,900	4.97	5.30
1924	3	336	950	2.83	1.05
1925	1	1,377	3,900	2.83	3.96
1926	------	------	------	------	------
1927	1	23	(2)	------	------
Montana:					
1923	10	151,903	274,218	1.80	2.10
1924	9	39,776	84,770	2.13	.77
1925	6	42,572	54,684	1.28	.57
1926	6	22,205	43,000	1.94	.64
1927	4	21,730	36,308	1.67	1.08
Nevada:					
1923	32	1,246,003	3,200,209	2.57	.375
1924	25	965,995	2,703,706	2.80	.36
1925	16	801,141	2,123,687	2.65	.41
1926	15	717,582	1,787,957	2.49	.41
1927	22	446,869	1,105,600	2.47	.36
New Mexico:					
1923	1	47,644	61,391	1.29	.18
1924	1	72,736	112,500	1.55	.195
1925	1	52,118	81,159	1.56	.18
1926	1	750	1,125	1.50	.16
1927	------	------	------	------	------
South Dakota:					
1923	4	1,639,321	361,900	.22	2.825
1924	3	1,647,344	361,650	.22	2.86
1925	3	1,567,555	347,242	.22	2.79
1926	3	1,402,472	299,672	.21	2.35
1927	3	1,353,298	312,626	.23	2.03
Texas:					
1923	1	78,322	83,804	1.07	.10
1924	1	84,744	70,995	.84	.10
1925	1	72,685	43,691	.60	.08
1926	1	33,818	24,375	.72	.06
1927	1	48,190	96,813	2.01	.12
Utah:					
1923	1	14,301	43,731	3.06	1.06
1924	------	------	(2)	------	------
1925–1927	------	------	------	------	------
Washington:					
1923	1	12	50	4.17	6.25
1924–1927	------	------	------	------	------

[1] Partly estimated.

[2] Quantity small; figures not available.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By C. N. GERRY[1]

SUMMARY

The output of gold, silver, copper, lead, and zinc from Utah mines in 1927 was valued at $73,626,632; the decrease of $9,036,252 in comparison with 1926 was due chiefly to lower metal prices. There were 123 producing lode mines and no active placers in 1927, compared with 164 lode mines and 2 placers in 1926. The output of ore and the total value of each metal except gold decreased considerably, although the quantity of both lead and zinc increased. The output of gold increased from $3,778,046 to $4,008,451, lead from 295,270,025 to 302,570,040 pounds, and zinc from 95,179,380 to 99,185,443 pounds; silver decreased from 19,358,581 to 18,606,950 ounces and copper from 257,464,482 to 256,933,278 pounds. Compared with other States, Utah was first in the output of silver in 1927 (as it has been since 1920), second again in copper and lead, fifth again in zinc, and sixth again in gold. Salt Lake County, which includes the Bingham district, again led in total value of metal output in 1927 as well as in the production of gold, copper, lead, and zinc. Wasatch County, which includes part of the Park City region, was second in the total value of metals, second in gold, silver, and zinc, and third in copper and lead. Juab County, which includes a large part of the Tintic district, was third in the total value of metals, first in silver, second in copper, and third in gold.

Since 1864 Utah has yielded an output of the five metals, as follows: Gold, $121,875,938; silver, 529,389,541 fine ounces; copper, 3,773,826,378 pounds; lead, 5,973,663,515 pounds; and zinc, 505,004,229 pounds. The total value of this output has been $1,531,256,043.

Published dividends of seven mining companies amounted to $15,463,401 in 1927, making a recorded total of $294,534,770 paid to stockholders. In 1926 dividends paid by 14 companies amounted to $15,270,498. Twenty-one per cent of the total value of the metal output in 1927 was paid in dividends, and more than 19 per cent of the total value of metal output since 1864 has been paid in dividends. The dividends stated above for 1927 do not include $2,931,127 paid by the United States Smelting, Refining & Mining Co., which controls mines in other States and in Mexico, besides those at Eureka and Bingham, Utah. The seven companies that contributed to the total dividends in 1927 were the Utah Copper, Tintic Standard, Park Utah Consolidated, Silver King Coalition, Plutus, Bingham Mines, and Cardiff.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

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[1] The valuable assistance of B. N. Lowry and Paul Luff, of the Bureau of Mines, is acknowledged.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

Mine production of gold, silver, copper, lead, and zinc in Utah, 1918–1927

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1918	248	3	14,705,718	142,666.10	$2,949,170	13,455,597	$13,455,597
1919	179	--------	6,745,423	104,464.41	2,159,471	11,649,961	13,047,956
1920	161	3	6,800,180	97,454.15	2,014,556	13,106,976	14,286,604
1921	134	4	2,137,522	85,619.15	1,769,905	12,251,998	12,251,998
1922	147	7	5,560,034	111,110.36	2,296,855	17,271,100	17,271,100
1923	146	4	12,752,998	148,824.86	3,076,483	19,137,470	15,692,725
1924	136	2	13,640,618	146,486.85	3,028,152	17,253,692	11,559,974
1925	179	--------	14,479,247	177,803.08	3,675,516	21,276,689	14,766,022
1926	164	2	15,856,144	182,762.98	3,778,046	19,358,581	12,079,755
1927	123	--------	15,757,074	193,908.82	4,008,451	18,606,950	10,550,141

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	227,169,630	$56,110,899	167,008,224	$11,857,584	18,399,417	$1,674,347	$86,047,597
1919	124,061,807	23,075,496	123,829,051	6,562,940	4,431,024	323,465	45,169,328
1920	116,931,238	21,515,348	140,838,113	11,267,049	8,157,739	660,777	49,744,334
1921	30,891,403	3,984,991	89.187,269	4,013,427	69,390	3,469	22,023,790
1922	97,193,850	13,121,170	135,332,144	7,443,268	5,119,410	291,806	40,424,199
1923	222,393,572	32,691,855	203,447,793	14,241,346	11,330,913	770,502	66,472,911
1924	242,138,165	31,720,100	233,910,875	18,712,870	18,562,172	1,206,541	66,227,637
1925	236,486,540	33,581,089	306,669,824	26,680,275	52,611,732	3,998,492	82,701,394
1926	257,464,482	36,045,027	295,270,025	23,621,602	95,179,380	7,138,454	82,662,884
1927	256,933,278	33,658,259	302,570,040	19,061,913	99,185,443	6,347,868	73,626,632

GOLD

The mine production of gold in Utah in 1927 increased 6 per cent over 1926; most of it came from Salt Lake, Wasatch, Juab, and Utah Counties, here named in order of output. The gain was particularly notable in Wasatch County and was due to the increased output of lead-zinc ore. The decrease in the production of gold in Juab County was unusually large, especially from the Bullion Beck, Chief, and Mammoth properties. The large increase in the production of gold from the property of the Park Utah Consolidated Mines Co. in the

Park City region more than offset the decrease in gold from the Bingham property of the United States Smelting, Refining & Mining Co. and from the old tailings dumps of the Mammoth and Bullion Beck mines near Eureka. Gold in Utah is now produced almost entirely as a by-product from smelting and refining copper and lead ores and concentrates and from zinc residues.

The Utah Copper property at Bingham was the largest producer of gold in Utah in 1927, the property of the Park Utah Consolidated Mines Co. was second, and the Bingham property of the United States Smelting, Refining & Mining Co. was third; the Utah-Delaware, Mammoth tailings dump, Utah-Apex, Tintic Standard, Chief Consolidated, Silver King Coalition, and Bingham Mines Co. followed.

SILVER

In 1927 Utah was again the largest producer of silver in the United States, although the quantity produced decreased 4 per cent from the output of 1926. Juab County again led in output, followed closely by Wasatch, Salt Lake, Utah, and Summit Counties. The decrease was especially notable in the Tintic district; there was an increase in both the Park City region and in the Bingham district. Most of the silver was recovered at plants in the East from bullion produced from crude ore and concentrates treated at the Murray, Midvale, and International smelters. Utah has no copper or lead refineries, and no silver bullion or precipitates from cyanidation or chlorination mills were marketed.

Eight properties in Utah each produced more than 700,000 ounces of silver in 1927; these properties were the Park Utah Consolidated in the Park City region, the Tintic Standard in the Tintic district, the Silver King Coalition in the Park City region, the Bingham Mines Co. operating properties at Bingham and in the Tintic district, the Plutus in the Tintic district, the Utah Copper Co. at Bingham, the Chief Consolidated in the Tintic district, and the property of the United States Smelting, Refining & Mining Co. at Bingham.

COPPER

In 1927 Utah was again the second largest producer of copper in the United States, although the output was slightly less than the record output of 1926. More than 97 per cent of the copper came from the Bingham or West Mountain district, Salt Lake County; the remainder of the output came chiefly from the Tintic district, Juab and Utah Counties, and the Park City region, Summit and Wasatch Counties. Crude ore shipped to smelters yielded 10,847,075 pounds of copper, against 10,951,752 pounds in 1926. Of the copper from crude copper ore smelted, 5,762,080 pounds came from sulphide ores and 185,338 pounds from oxidized ores; of the copper from crude lead ores smelted, 2,089,947 pounds came from sulphide ores and 569,665 pounds from oxidized ores. The copper-lead ores smelted were chiefly sulphide; they yielded 178,368 pounds of copper. The dry and siliceous ore, used chiefly as a flux at smelting plants, yielded 2,061,677 pounds of copper, against 1,317,301 pounds in 1926. The low-grade disseminated ores that were concentrated yielded 232,284,968 pounds of copper, against 233,465,293 pounds in 1926.

The leading copper producers in Utah in 1927 were, in order of output, the Utah Copper Co. (which reported 233,002,661 net pounds, a decrease from 234,173,625 net pounds reported in 1926), Utah-Apex, Ohio Copper, Utah-Delaware, Park Utah Consolidated, Silver King Coalition, Mammoth mine, Mammoth tailing dump, and Bingham Mines Co. The Ohio Copper Co. at Lark, in addition to considerable work in prospecting from the Mascotte tunnel, continued to leach in place the caved area of the mine, but the yield of copper from precipitates or cement copper was slightly less than that of 1926.

LEAD

In 1927 Utah again ranked second among the States as a producer of lead; the quantity produced increased more than 2 per cent over that of 1926, as a result of the increased shipments of lead-zinc ore from the Park City region. There was a decided decrease in the production of lead from the western part of the Tintic district in Juab County but a large increase from the eastern part of the district in Utah County. The Bingham or West Mountain district produced 111,015,187 pounds of lead, compared with 109,993,099 pounds in 1926. Most of the lead output at Bingham came from the Utah-Delaware mine, from the property of the United States Smelting, Refining & Mining Co., and from the Utah-Apex mine; the Park City region produced 82,805,275 pounds, against 71,819,276 pounds in 1926; the Tintic district produced 90,089,355 pounds, against 94,216,430 pounds; the combined production of the Ophir and Rush Valley districts (chiefly the latter), Tooele County, increased from 10,478,961 to 15,006,795 pounds; the output in Beaver County decreased from 4,180,434 to 1,186,328 pounds; and the combined production of the Big and Little Cottonwood districts, Salt Lake County, decreased from 3,194,890 to 2,017,283 pounds.

The Park Utah Consolidated property in the Park City region ranked first in lead output in Utah in 1927. It was followed in order by the Tintic Standard property (including the Iron Blossom mine) in the Tintic district, the Silver King Coalition mine in the Park City region, and the Utah-Delaware mine, the United States Smelting, Refining & Mining Co.'s property, and the Utah-Apex mine at Bingham. Each of these was credited with producing more than 24,000,000 pounds of lead. Next in rank were the Bingham Mines Co., Plutus, North Lily, Bullion Coalition, and Chief Consolidated properties.

ZINC

The mine production of zinc in Utah in 1927 was the largest ever reported for the State, exceeding by 4 per cent the former record—that of 1926. Although there was a decrease in 1927 of 1.1 cents a pound in the average price of zinc, production increased. This increase was due chiefly to improved milling facilities and to increased output of lead-zinc ore from the Park Utah mine, in the Park City region. The increase in the quantity of zinc recovered from ores mined in the Park City region more than offset the decreases in zinc output from the Tintic and Bingham districts. The large custom and private mills treating lead-zinc ores in Utah have become consistent producers with an adequate supply of ore. They are not quickly affected by the fluctuations in the price of zinc, because they produce lead concentrate and iron concentrate, sold locally, which contain other valuable metals.

The Park Utah Consolidated Mines Co., operating in the Park City region, ranked first in zinc output in Utah in 1927 and was followed by the mines of the United States Smelting, Refining & Mining Co. at Bingham; other large zinc producers were the Utah-Delaware, Silver King Coalition, Utah-Apex, Bullion Coalition, Ontario Silver, Utah Copper, and Chief Consolidated properties.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1927, by counties

County	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
Beaver	325.71	$6,733	46,617	$26,432
Box Elder	.68	14	52	29
Garfield	3.77	78	--------	--------
Juab	21,768.70	449,999	4,165,136	2,361,632
Morgan	.78	16	472	268
Piute	12.24	253	229	130
Salt Lake	124,550.19	2,574,681	3,734,478	2,117,449
Summit	4,170.80	86,218	3,175,129	1,800,298
Tooele	3,906.96	80,764	287,613	163,077
Utah	11,042.27	228,264	3,437,086	1,948,828
Wasatch	28,126.72	581,431	3,760,138	2,131,998
	193,908.82	4,008,451	18,606,950	10,550,141
Total, 1926	182,762.98	3,778,046	19,358,581	12,079,755

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	53,459	$7,003	1,186,328	$74,739	97,886	$6,265	$121,172
Box Elder	11,320	1,483	19,292	1,215	--------	--------	2,741
Garfield	--------	--------	--------	--------	--------	--------	78
Juab	3,209,707	420,471	37,452,242	2,359,491	1,051,534	67,298	5,658,891
Morgan	298	39	41,803	2,634	--------	--------	2,957
Piute	31	4	4,920	310	--------	--------	697
Salt Lake	250,172,078	32,772,542	113,153,693	7,128,683	49,134,361	3,144,599	47,737,954
Summit	1,244,634	163,047	40,137,322	2,528,651	12,391,525	793,057	5,371,271
Tooele	229,816	30,106	15,207,230	958,056	4,045,448	258,909	1,490,912
Utah	661,150	86,611	52,699,257	3,320,053	--------	--------	5,583,756
Wasatch	1,350,785	176,953	42,667,953	2,688,081	32,464,689	2,077,740	7,656,203
	256,933,278	33,658,259	302,570,040	19,061,913	99,185,443	6,347,868	73,626,632
Total, 1926	257,464,482	36,045,027	295,270,025	23,621,602	95,179,380	7,138,454	82,662,884

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Utah, 1926–27, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1926	1927	1926	1927	1926	1927
Beaver	38,511	9,357	11	6	$3.86	$3.54
Box Elder	239	126	2	4	22.85	.34
Cache	3	--------	1	--------	.33	--------
Garfield	--------	10	--------	1	--------	7.80
Iron	21	--------	1	--------	13.57	--------
Juab	407,974	300,501	27	28	9.38	9.36
Millard	453	--------	3	--------	.85	--------
Morgan	200	127	1	1	1.97	2.24
Piute	594	35	3	1	20.31	10.94
Salt Lake	14,534,268	14,524,824	44	35	.33	.32
Summit	395,290	347,087	11	8	4.91	5.44
Tooele	40,537	68,790	41	23	4.42	3.54
Utah	139,655	146,953	16	12	16.70	14.81
Wasatch	298,339	359,264	3	4	8.66	7.55
	15,856,144	15,757,074	164	123	1.00	.92

MINING INDUSTRY

Although the average metal prices in 1927 were considerably less than those in 1926 and the total value of the metals recovered from Utah mines decreased 11 per cent, general conditions for mining in Utah were good, and dividend payments were slightly increased. The output of several of the large mines, such as the Tintic Standard, Utah-Apex, Chief Consolidated, and Mammoth properties, was much less than in recent years, but there were many examples of increased production, such as that of the Park Utah, Silver King Coalition, Stockton Lead, Bullion Coalition, and Victoria mines. Several new properties—North Lily, Eureka Lilly, and Park Galena—were added to the list of producers. Development proceeded at a normal rate in the main districts, and vigorous work was done in the eastern part of the Tintic district. The output of ore, old tailings, etc., was slightly less than that of 1926, the chief decrease being in the Tintic district. There was a decrease in the lead ore marketed in Utah but a fair increase in lead and zinc recovered from lead-zinc ore.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Utah, 1918–1927, with content in terms of recovered metals

DRY AND SILICEOUS ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	227,356	22,815.44	3,987,068	3,189,201	1,214,547	------------
1919	239,688	25,216.63	3,645,909	2,758,479	1,438,014	------------
1920	291,020	33,347.99	3,955,771	2,116,803	6,282,276	------------
1921	376,472	29,554.10	6,088,635	1,371,654	8,735,063	------------
1922	414,339	38,353.62	8,110,733	2,635,080	8,693,250	------------
1923	346,425	32,714.51	6,737,300	2,852,586	6,358,703	------------
1924	282,226	27,098.75	4,749,144	1,998,016	7,137,005	------------
1925	389,030	34,269.82	4,434,524	3,926,172	10,134,106	------------
1926	301,213	24,097.08	3,365,644	2,970,610	6,408,867	------------
1927	245,344	22,709.99	2,577,357	3,072,539	5,713,355	------------
COPPER ORE						
1918	13,512,274	75,960.07	1,445,559	[1]217,252,784	2,557	------------
1919	5,884,118	38,873.71	586,417	[1]116,312,084	1,231	------------
1920	5,778,373	31,845.51	452,915	[1]108,645,375	31,461	------------
1921	1,357,857	14,384.74	229,556	[1]27,321,481	255,567	------------
1922	4,509,384	36,398.64	473,284	[1]91,088,007	252,970	------------
1923	11,519,727	84,203.12	867,618	[1]214,305,888	30,852	------------
1924	12,357,366	83,444.56	887,541	[1]234,954,343	199,275	------------
1925	12,575,265	87,168.24	[1]959,790	[1]223,484,426	701,063	------------
1926	13,949,866	100,853.65	1,281,767	[1]245,328,789	582,261	------------
1927	13,879,173	100,057.71	[1]1,138,014	[1]244,279,301	242,552	------------
LEAD ORE						
1918	527,759	20,225.49	6,672,725	4,843,721	113,517,267	------------
1919	435,541	17,555.14	6,664,219	4,157,256	95,881,706	------------
1920	559,896	18,185.95	7,895,007	4,961,482	111,133,846	------------
1921	401,429	41,628.44	5,893,497	2,088,255	79,519,436	69,390
1922	507,450	17,853.25	8,183,741	2,945,328	107,416,311	------------
1923	645,991	21,365.84	10,648,952	4,494,047	168,875,684	16,535
1924	729,219	24,380.08	9,936,956	4,138,013	179,798,884	403,789
1925	699,361	27,002.58	10,318,309	5,874,744	185,821,166	------------
1926	383,857	19,095.25	7,307,599	4,038,262	130,674,816	------------
1927	337,734	19,868.69	7,214,271	2,665,402	131,088,261	------------

[1] Includes metal saved from precipitates.

Ore, old tailings, etc., sold or treated in Utah, 1918–1927, with content in terms of recovered metals—Continued

COPPER-LEAD ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	7,495	118.96	106,377	219,476	1,125,021	--------
1919	1,924	32.56	38,936	125,645	746,640	--------
1920	6,389	223.78	172,401	407,397	2,155,329	--------
1921	1,764	31.84	40,309	110,013	677,203	--------
1922	1,272	35.14	20,919	125,233	137,399	--------
1923	971	24.96	30,924	90,624	164,495	--------
1924	19	1.76	462	5,257	3,294	--------
1925	13	.04	55	1,370	1,924	--------
1926	--------	--------	--------	--------	--------	--------
1927	73,878	1,016.36	169,111	2,218,716	3,902,896	--------

ZINC ORE AND LEAD-ZINC ORE [2]

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1918	430,834	23,479.96	1,243,853	1,664,448	51,148,832	18,399,417
1919	184,152	22,786.37	714,480	708,343	25,761,460	4,431,024
1920	164,502	13,829.01	630,875	800,181	21,235,201	8,157,739
1921	--------	--------	--------	--------	--------	--------
1922	127,589	18,366.67	482,417	400,202	18,832,214	5,119,410
1923	239,884	10,490.94	852,673	650,427	28,018,059	11,314,378
1924	271,788	11,550.48	1,679,588	1,042,536	46,772,417	18,158,383
1925 [2]	815,578	29,362.40	5,564,011	3,199,828	110,011,565	52,611,732
1926	1,221,208	38,700.84	7,403,570	5,126,821	157,604,081	95,179,380
1927	1,220,945	50,256.07	7,508,197	4,697,320	161,622,976	99,185,443

[2] Includes copper-lead-zinc ore in 1925 as follows: 563 tons, yielding 5.07 ounces of gold, 3,957 ounces of silver, 10,194 pounds of copper, 136,737 pounds of lead, and 212,159 pounds of zinc.

Ore, old tailings, etc., sold or treated in Utah in 1927, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	7	4,226	0.03	3,390.88	1.75	26,151	0.14
Dry gold and silver ore	5	[1] 83,004	.53	7,667.38	3.95	318,110	1.71
Dry silver ore	26	[2] 158,114	1.00	11,651.73	6.01	2,233,096	12.00
Copper ore	19	13,879,173	88.08	100,057.71	51.60	[3] 1,138,014	6.12
Lead ore	86	[4] 337,734	2.14	19,868.69	10.25	7,214,271	38.77
Copper-lead ore	4	73,878	.47	1,016.36	.52	169,111	.91
Lead-zinc ore	34	[5] 1,220,945	7.75	50,256.07	25.92	7,508,197	40.35
	[6] 123	15,757,074	100.00	193,908.82	100.00	[3] 18,606,950	100.00
Total, 1926	166	15,856,144	--------	182,762.98	--------	19,358,581	--------

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[1] Includes 82,421 tons of old tailings sold to a smelter.

[2] Includes 15,074 tons of old tailings sold to a smelter and 23,400 tons of old tailings treated in a volatilization plant.

[3] Includes 21 ounces of silver saved from precipitates.

[4] Includes 419 tons of old tailings and 11 tons of slag sold to smelters.

[5] Includes 167,352 tons of old tailings concentrated.

[6] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

Ore, old tailings, etc., sold or treated in Utah in 1927, with content in terms of recovered metals—Continued

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	60,720	0.02	29,767	0.01		
Dry gold and silver ore	921,428	.36	696,616	.23		
Dry silver ore	2,090,391	.81	4,986,972	1.65		
Copper ore	[7] 244,279,301	95.08	242,552	.08		
Lead ore	2,665,402	1.04	131,088,261	43.32		
Copper-lead ore	2,218,716	.86	3,902,896	1.29		
Lead-zinc ore	4,697,320	1.83	161,622,976	53.42	99,185,443	100.00
	[7] 256,933,278	100.00	302,570,040	100.00	99,185,443	100.00
Total, 1926	[8] 257,464,482		295,270,025		95,179,380	

[7] Includes 6,046,915 pounds of copper saved from precipitates.
[8] Includes 6,187,049 pounds of copper saved from precipitates.

Value of metals from ore, old tailings, etc., sold or treated in Utah in 1927, by kinds of ore

Kind of ore	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	4,226	$70,096	$14,828	$7,954	$1,875		$94,753
Dry gold and silver ore	83,004	158,499	180,368	120,707	43,887		503,461
Dry silver ore	158,114	240,863	1,266,165	273,841	314,179		2,095,048
Copper ore	13,879,173	2,068,376	[1] 645,254	[1] 32,000,588	15,281		34,729,499
Lead ore	337,734	410,722	4,090,492	349,168	8,258,560		13,108,942
Copper-lead ore	73,878	21,010	95,886	290,652	245,883		653,431
Lead-zinc ore	1,220,945	1,038,885	4,257,148	615,349	10,182,248	$6,347,868	22,441,498
	15,757,074	4,008,451	[1] 10,550,141	[1] 33,658,259	19,061,913	6,347,868	73,626,632
Total, 1926	15,856,144	3,777,712	12,079,754	[2] 36,045,027	23,621,602	7,138,454	82,662,549

[1] Includes value of 21 ounces of silver and 6,046,915 pounds of copper saved from precipitates.
[2] Includes value of 6,187,049 pounds of copper saved from precipitates.

GOLD ORE

The metals recovered from gold ore were valued at $94,753, an average of $22.42 a ton. The ore yielded on the average 0.802 ounce of gold and 6.19 ounces of silver to the ton and a little copper and lead. More than 88 per cent of the gold ore was mined from three properties in the West Mountain and Tintic districts.

GOLD AND SILVER ORE

Five mines in 1927, compared with six in 1926, produced siliceous gold and silver ore and old tailings which yielded on the average 0.092 ounce of gold and 3.83 ounces of silver to the ton, 0.56 per cent of copper, and 0.42 per cent of lead. Nearly all the gold and silver material was old tailings shipped from the Mammoth dump in the Tintic district, Juab County.

SILVER ORE

Dry and siliceous silver ore and old tailings were produced by 26 mines in 1927, compared with 31 in 1926, and yielded on the average $1.52 in gold, 14.12 ounces of silver, 13.22 pounds of copper, and 31.54 pounds of lead to the ton. The metals recovered from the ore and old tailings were valued at $2,095,048, an average of $13.25 a ton. Nineteen mines in the Tintic district in Juab and Utah Counties produced 145,676 tons of silver ore and old tailings, or 92 per cent of the total. The largest producers of this material were the Tintic Standard, Eureka Hill tailings dump, Eagle & Blue Bell, Mammoth, and Chief Consolidated properties, all in the Tintic district.

COPPER ORE

Copper ore represented 88 per cent of the total ore, old tailings, etc., produced in Utah in 1927; it yielded on the average 0.007 ounce of gold, 0.08 ounce of silver, 17.16 pounds of copper, and a little lead to the ton, and the average value in metals per ton was $2.45. Salt Lake County produced nearly all the copper ore, chiefly from the Utah Copper property at Bingham. Other leading producers of copper ore were the Utah-Delaware and Utah-Apex properties, also at Bingham.

LEAD ORE

The metals recovered from lead ore, old tailings, and slag in 1927 were valued at $13,108,942, an average of $38.81 to the ton. The ore, etc., came from 86 mines and averaged 0.059 ounce of gold and 21.36 ounces of silver to the ton, 0.39 per cent of copper, and 19.41 per cent of lead. More than 61 per cent of this material was produced from 18 mines in the Tintic district, and nearly 20 per cent came from 15 mines in the Bingham district. There were unusually large decreases in the output of lead ore from the Eagle & Blue Bell, Mammoth, Utah-Apex, and Utah-Delaware properties, but there were good increases from the Plutus, Victoria, Dalton & Lark (Bingham Mines Co.), Utah Copper, and Bluestone mines. In 1926 there were 121 mines producing lead ore, etc., with a value in metals of $15,974,018. The largest producer of lead ore in Utah in 1927 was the Tintic Standard mine at Dividend in the Tintic district. It was followed in order by the Plutus mine, also in the Tintic district; the Bingham Mines at Bingham; the Chief Consolidated and North Lily properties, in the Tintic district; the Silver King Coalition mine, at Park City; and the Victoria mine (Bingham Mines Co.) in the Tintic district. The Utah-Apex Mining Co. with property at Bingham, the second largest producer of lead ore in Utah in 1926, shipped much less first-class lead ore in 1927 but distinctly increased its output of copper-lead ore.

COPPER-LEAD ORE

Four mines in 1927 produced copper-lead ore which yielded on the average 0.014 ounce of gold and 2.29 ounces of silver to the ton, 1.50 per cent of copper, and 2.64 per cent of lead. The metals recovered from the ore were valued at $653,431, an average of $8.84 a ton. Most of the copper-lead ore was produced from the Utah-Apex mine at Bingham; the Cardiff property in Big Cottonwood district also produced considerable copper-lead ore.

LEAD-ZINC ORE

All the zinc produced by Utah mines in 1927 was recovered from lead-zinc ore and old tailings. The output of this material increased slightly over 1926 and yielded on the average 0.041 ounce of gold and 6.15 ounces of silver to the ton, 0.19 per cent of copper, 6.62 per cent of lead, and 4.06 per cent of zinc. More than 41 per cent of it came from the Bingham or West Mountain district and 55 per cent from the Park

City region. Most of the output from these districts was concentrated at the custom flotation plants at Midvale, Bauer, and International, where an increased quantity of custom ore was treated. Most of the zinc product from lead-zinc ore was shipped to the electrolytic zinc plant at Great Falls, Mont., but a large part of it went to Amarillo, Tex., and to Bartlesville and Henryetta, Okla. The largest producers of lead-zinc ore in Utah in 1927 were the Park Utah Consolidated mines, in the Park City region; the property of the United States Smelting, Refining & Mining Co. and the Utah-Delaware mine, both at Bingham; the Silver King Coalition mine at Park City; and the Utah-Apex mine at Bingham. A large quantity of old tailings from Park City was reconcentrated, but the metals recovered were less than those saved from similar operations in 1926.

Ore, old tailings, etc., sold or treated in Utah in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Garfield	10	3.80				
Salt Lake	1,324	1,258.57	9,551	55,695	15,066	
Tooele	154	913.00	119	453	7,701	
Utah	2,738	1,215.51	16,481	4,572	7,000	
	4,226	3,390.88	26,151	60,720	29,767	
Total, 1926	344	1,297.40	643	1,194		
DRY GOLD AND SILVER ORE						
Juab	[1] 82,421	7,545.00	312,953	920,226	696,000	
Salt Lake	119	29.74	1,318	397	616	
Utah	464	92.64	3,839	805		
	83,004	7,667.38	318,110	921,428	696,616	
Total, 1926	113,476	14,165.75	460,672	1,353,154	434,221	
DRY SILVER ORE						
Beaver	[2] 6,007	144.42	23,392	31,113	236,000	
Juab	[3] 109,379	9,379.40	1,257,876	1,782,050	3,137,615	
Salt Lake	163	13.81	1,888	113	10,000	
Tooele	43	.15	300	1,064	357	
Utah	36,297	1,795.85	820,158	235,948	1,384,000	
Wasatch	6,225	318.10	129,482	40,103	219,000	
	158,114	11,651.73	2,233,096	2,090,391	4,986,972	
Total, 1926	187,393	8,633.93	2,904,329	1,616,262	5,974,646	
COPPER ORE						
Box Elder	86	0.67	35	11,320		
Juab	270	20.12	4,119	26,498		
Salt Lake	13,877,620	98,476.35	[4] 1,124,782	[4] 244,153,331	226,000	
Tooele	14	2.66	29	938		
Utah	1,183	1,557.91	9,049	87,214	16,552	
	13,879,173	100,057.71	[4] 1,138,014	[4] 244,279,301	242,552	
Total, 1926	13,949,866	100,853.65	1,281,767	[5] 245,328,789	582,261	

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[1] Old tailings sold to a smelter.

[2] Includes 5,765 tons of old tailings sold to a smelter.

[3] Includes 23,400 tons of old tailings treated in a volatilization plant and 9,309 tons of old tailings sold to a smelter.

[4] Includes 21 ounces of silver and 6,046,915 pounds of copper saved from precipitates.

[5] Includes 6,187,049 pounds of copper saved from precipitates.

Ore, old tailings, etc., sold or treated in Utah in 1927, by counties, with content in terms of recovered metals—Continued

LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	3,137	177.68	22,404	22,025	902,698	
Box Elder	40		17		19,292	
Juab	100,214	4,717.51	2,510,846	471,814	32,172,516	
Morgan	127	.80	472	298	41,803	
Piute	35	12.22	229	31	4,920	
Salt Lake	[6]68,321	4,850.82	672,108	1,038,725	21,188,062	
Summit	[7]21,762	1,146.71	1,096,469	554,045	12,310,504	
Tooele	32,537	2,391.57	199,495	183,917	11,645,687	
Utah	106,269	6,380.28	2,587,511	332,466	51,290,968	
Wasatch	5,292	191.10	124,720	62,081	1,511,811	
	337,734	19,868.69	7,214,271	2,665,402	131,088,261	
Total, 1926	383,857	19,095.25	7,307,599	4,038,262	130,674,816	

LEAD-ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaver	213	3.59	821	321	47,630	97,886
Juab	8,217	106.65	79,342	9,119	1,446,111	1,051,534
Salt Lake	[8]503,442	18,905.62	1,756,218	2,708,446	87,819,790	49,134,361
Summit	[9]325,325	3,024.10	2,078,660	690,589	27,826,818	12,391,525
Tooele	[10]36,001	598.59	87,220	40,244	3,545,485	4,045,448
Wasatch	347,747	27,617.52	3,505,936	1,248,601	40,937,142	32,464,689
	1,220,945	50,256.07	7,508,197	4,697,320	161,622,976	99,185,443
Total, 1926	1,218,635	38,698.86	7,402,838	5,125,621	157,597,731	95,021,047

[6] Includes 52 tons of old tailings and 11 tons of slag sold to smelters.
[7] Includes 367 tons of old tailings sold to a smelter.
[8] Includes 457 tons of old tailings concentrated.
[9] Includes 147,354 tons of old tailings concentrated.
[10] Includes 19,541 tons of old tailings concentrated.

The following table gives the kind and grade of zinc material marketed in 1927:

Zinc concentrates (as marketed from Utah mills) sold to smelters in 1927

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Zinc concentrates	Beaver, Juab, Salt Lake, Summit, Tooele, and Wasatch.	107,632	115,105,428	53.47	99,185,443
		107,632	115,105,428	53.47	99,185,443

METALLURGIC INDUSTRY

In 1927 most (96 per cent) of the ore, etc., from Utah mines was concentrated; the resulting concentrates, with the first-class shipping ore, the old tailings, precipitates, etc., were smelted and yielded metals valued at $73,626,554. Only a little ore was amalgamated; it yielded gold bullion valued at $78.

In the last decade Utah has become a smelting center of first importance, with large custom copper plants at Garfield and International and lead plants at Midvale, Murray, and International; these smelters are discussed under Salt Lake and Tooele Counties.

Marked improvement has been made in the milling practice of Utah by the adoption of differential flotation at the large mills. At the enormous mills of the Utah Copper Co. the recovery of copper in concentrate has increased from 65 per cent during the war period to 89 per cent in 1927. Regular and more efficient operations prevailed at the custom mills treating lead-zinc ore at International, Midvale, and Bauer and also at local plants at the Silver King Coalition, Utah-Apex, and Chief Consolidated mines, although the Chief Consolidated plant was not operated full time.

In Utah 16 milling plants were running in 1927; 2 of these plants used tables followed by flotation devices, 4 used ordinary table concentration, 9 used straight flotation, and 1 was a volatilization plant in which lead ore was roasted in a rotary kiln. At seven properties copper was precipitated from mine water or from ore leached in place, and most of this copper was recovered at the plant of the Ohio Copper Co. at Bingham, where regular leaching work is done.

A list of the active and idle milling plants in Utah in 1925, prepared by the Bureau of Mines, may be had upon request. This list gives the process and equipment of each mill designed to treat ore in Utah.

A list of the large mills in Utah that were active in 1927 follows:

Large mills in Utah active in 1927

Name of company and location of mill	Capacity of mill	Actually treated	Kind of material treated	Product
	Short tons per day	*Short tons per day*		
Utah Copper Co., Magna and Arthur.	45,000	40,385	Copper ore	Copper concentrate.
International Smelting Co. (custom plant), International.	1,000	1,000	Lead-zinc-iron ore.	Lead, zinc, and iron concentrates.
United States Smelting, Refining & Mining Co. (custom plant), Midvale.	800	800	do	Do.
Combined Metals Reduction Co. (custom plant), Bauer.	150	150	do	Do.
Silver King Coalition Mines Co., Park City.	600	400	Lead-zinc ore	Silver-lead concentrate and zinc concentrate.
Chief Consolidated Mining Co., Eureka.	100	90	do	Lead concentrate and zinc concentrate.
Utah-Apex Mining Co., Bingham.	800	650	Lead-zinc ore and copper-lead ore.	Lead concentrate, zinc concentrate, and copper concentrate.

Flotation, which has made such interesting strides in Utah, is well described in the revised quarterly[2] of the School of Mines at Golden, Colo. This publication discusses the theory of flotation, reagents used, general operations, equipment, testing, and practice, and gives a comprehensive bibliography. The practice at International and at Midvale is briefly given. An article[3] describing practice at the mills of the Utah Copper Co., especially the change to an alkaline circuit and the improvement in the grade of concentrate by dropping pyrite, was published in January, 1927. An article[4] giving the flota-

[2] Weinig, Arthur J., and Palmer, Irving A., The Trend of Flotation: Colorado Sch. Mines Quart., vol. 23, No. 2, April, 1928.

[3] Howard, L. O., Selective Flotation and its Relation to Metallurgy: The Black Hills Eng., January, 1927, p. 14.

[4] Gaudin, A. M., Consumption of Reagents Used in Flotation, 1927: Repts. of Investigations, Serial 2931, Bureau of Mines, 1929.

tion reagents used in 1927 and the kinds of ore treated by flotation, with the results, was issued by the Bureau of Mines in 1929.

Concentrates produced in Utah in 1927 yielded 72 per cent of the gold, 46 per cent of the silver, 93 per cent of the copper, 54 per cent of the lead, and all of the zinc. There was a large decrease in the quantity of copper concentrates but an increase in lead concentrates; the quantity of zinc concentrates made was about the same as in 1926. The dry and siliceous concentrates included a large quantity of iron concentrates, containing gold and silver with a little copper and lead, made at custom flotation plants treating galena-sphalerite-pyrite ores.

Ore of all kinds shipped to the smelters amounted to 3 per cent of the total output and yielded 23 per cent of the gold, 52 per cent of the silver, 4 per cent of the copper, and 45 per cent of the lead. A substantial decrease was recorded in the shipment of first-class lead ore, with small decreases in copper ore and siliceous ore.

The miscellaneous material, other than ore and old tailings concentrated and crude ore smelted, consisted of 97,925 tons of slag and old tailings shipped for smelting, 25,218 tons of ore and old tailings shipped to a volatilization plant, and copper precipitates from mine water and from leaching of ore in place. This miscellaneous material yielded 8,582.72 ounces of gold, 460,352 ounces of silver, 7,062,994 pounds of copper, and 2,677,039 pounds of lead, valued in all at $1,532,346; most of the gold, silver, and lead in this material came from old tailings from the Tintic district, Juab County, whereas most of the copper came from the leaching of ore from the Bingham or West Mountain district, Salt Lake County. Part of the miscellaneous material came from the San Francisco district, Beaver County.

Mine production of metals from Utah concentrates in 1927

BY COUNTIES

	Ore and old tailings to concentrating mills		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	213		174	3.59	821	321	47,630	97,886
Juab	8,259		3,149	106.85	80,245	9,164	1,456,949	1,051,534
Piute	21		2	.40	74	31	801	
Salt Lake	14,385,353	457	677,971	109,153.54	2,727,717	237,034,259	90,319,826	49,134,361
Summit	177,971	147,354	40,832	3,024.10	2,078,660	690,589	27,826,818	12,391,525
Tooele	16,460	19,541	8,440	598.59	87,220	40,244	3,545,485	4,045,448
Wasatch	347,747		106,363	27,617.52	3,505,936	1,248,601	40,937,142	32,464,689
	14,936,024	167,352	836,931	140,504.59	8,480,673	239,023,209	164,134,651	99,185,443
Total, 1926	14,894,254	210,600	1,058,014	124,764.11	8,272,461	238,612,463	158,119,685	95,023,385

BY KINDS OF CONCENTRATES

Dry and siliceous	64,815	8,429.76	243,625	171,529	2,019,439	
Copper	485,361	89,902.00	927,239	234,163,513	118,000	
Lead	176,713	35,238.63	6,652,149	4,295,293	155,174,209	
Zinc	107,632	6,589.43	615,438	231,071	4,462,315	99,185,443
Copper-lead	2,410	344.77	42,222	161,803	2,360,688	

Mine production of metals from Utah crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	3,379	188.10	24,582	25,750	902,698	----------
Box Elder	126	.67	52	11,320	19,292	----------
Juab	177,112	13,383.03	3,657,617	2,217,069	34,081,453	----------
Morgan	127	.80	472	298	41,803	----------
Piute	14	11.82	155	----------	4,119	----------
Salt Lake	138,951	15,380.26	1,005,264	7,089,036	22,815,016	----------
Summit	21,395	1,133.77	1,094,102	551,854	12,267,156	----------
Tooele	32,789	3,308.38	200,393	189,572	11,661,745	----------
Utah	145,135	10,901.69	3,429,086	659,992	52,234,257	----------
Wasatch	11,517	509.20	254,202	102,184	1,730,811	----------
	530,545	44,817.72	9,665,925	10,847,075	135,758,350	----------
Total, 1926	568,004	42,361.59	10,205,700	10,951,752	132,704,743	155,995

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	124,439	14,293.39	2,128,869	2,061,677	3,563,515	----------
Copper	67,673	10,754.71	253,672	5,947,418	242,552	----------
Lead	335,291	19,697.02	7,199,413	2,659,612	130,528,075	----------
Copper-lead	3,142	72.60	83,971	178,368	1,424,208	----------

REVIEW BY COUNTIES AND DISTRICTS

BEAVER COUNTY

In 1927 six lode mines in Beaver County produced 9,357 tons of ore and old tailings, yielding metals valued at $121,172—a decrease from $528,941 in 1926. This decrease was due chiefly to smaller shipments of old tailings from the Horn Silver dump.

Beaver Lake district.—The Beaver Copper Co. continued to develop its property near Milford, and nearly 300 feet of sinking and crosscutting was done in 1927.

Lincoln district.—One car of sulphide lead ore was shipped from the Harriett group or Croff property, operated under lease by the Cinderella Mining Co. One lot of lead-zinc ore was also shipped to a custom milling plant for testing.

San Francisco district.—The Horn Silver mine at Frisco continued to be worked by lessees, who shipped about 1,700 tons of lead ore and a little silver ore to smelters; some lead-zinc ore was marketed for milling. Nearly 6,000 tons of old tailings, containing chiefly silver and lead, were shipped to a smelter. Practically all the slag and old tailings from this old producer have been disposed of, and the property was not worked vigorously at depth. The mine has been a consistent producer since its discovery in 1875, and the company has paid dividends amounting to nearly $7,000,000.

Star and North Star district.—Four lode mines in the Star district produced 1,634 tons of ore, which yielded $1,354 in gold, 6,867 ounces of silver, 4,816 pounds of copper, and 333,017 pounds of lead, valued in all at $26,859, or $16.44 in metals a ton. All the ore, an oxidized silver-lead ore chiefly from the Moscow mine, was shipped to smelters. The Moscow property, which is 8 miles southwest of Milford, was operated continuously in 1927, but the output decreased to about 1,000 tons of oxidized lead ore; the mine is opened by a shaft 1,400 feet deep, and approximately 2,000 feet of drifting and raising was done in 1927. Several cars of lead ore were also shipped from the Wild Bill property and from the Harrington-Hickory mine of the

Majestic Mines Co. One lot of carbonate lead ore was shipped from the Beaver Crown property, which is opened by a shaft and by several drifts from the 200-foot level; the ore consists of oxidized iron material containing wulfenite, cerussite, and galena. The Magnolia Mining Co. was organized to operate property 14 miles southwest of Milford, and a new shaft was started to prospect a seam containing various lead minerals, including wulfenite—lead molybdate.

BOX ELDER COUNTY

Ashbrook district.—The Skoro Consolidated Mining & Milling Co., operating the Apex and Liberty Bell groups in Utah, 28 miles south from Oakley, Idaho, did about 300 feet of development. The Lucky Guy's property was also being prospected.

Lucin district.—Lessees worked the Copper Mountain mine of the Salt Lake Copper Co., 12 miles southwest of Lucin, and shipped two cars of oxidized copper ore of smelting grade. A test lot of lead ore was shipped from the Nevada View property in the Pilot Range near Lucin.

Newfoundland district.—The Pacific Copper Co. shipped a small lot of copper ore from Groome, a loading station on the Southern Pacific Railroad.

Promontory district.—One lot of oxidized lead ore was shipped from the Lakeview mine near Promontory Point; this mine produced considerable lead-zinc ore in 1915 and 1916.

CACHE COUNTY

Richmond district.—The Emmett Mining & Milling Co. installed a compressor and engine at its property 4 miles northeast of Richmond and drove a lower tunnel to develop a fissure opened near the surface. Prospecting was also done at the Old Hatchet claims by the Richmond Mining Co.

DAVIS COUNTY

Several prospects in the Farmington district, such as the Free Gold and Layton claims, were being developed, but no ore was marketed in 1927.

GARFIELD COUNTY

Imperial district.—The Rico Association treated a test sample of gold ore in an arrastre. The company did considerable work in constructing a road to Green River, building new houses at the mine, increasing the milling capacity, and developing the property, which is opened by an adit and surface cuts.

JUAB COUNTY

Twenty-eight lode mines in Juab County produced metals valued at $5,658,891 in 1927, a marked decrease from $9,100,867 in 1926. Most of the ore and old tailings came from mines and dumps near Eureka, mentioned in the review of the Tintic district. The increase in the output of the Plutus mine and the Victoria (Bingham Mines Co.) mine was large, but a decided decrease was recorded from the Chief Consolidated, Mammoth, Mammoth tailings dump, and Eagle & Blue Bell mines.

Fish Springs district.—A test lot of lead ore was shipped from the Galena property, 75 miles from Oasis, and a little ore from the Emma and Utah mines, former producers of carbonate lead ore rich in silver, was concentrated. It is planned to unwater the Utah property and develop it below the 800-foot level.

Mount Nebo district.—About 1,200 feet of development was done at the Nebo Star mine by the Nebo Syndicate (Inc.); a car of silver-lead ore, partly oxidized, was shipped to Midvale for smelting.

Tintic district.—Several of the large mines in the eastern part of the Tintic district lie in Utah County, but they are reviewed here and their output is included in the following tables:

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Utah, 1926–27, and total, 1869–1927

	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1927								
Juab	24	300, 430	$449, 994	4, 163, 527	3, 209, 650	37, 410, 804	1, 051, 534	$5, 655, 357
Utah	7	145, 763	196, 055	3, 427, 879	573, 781	52, 678, 551	----------	5, 533, 577
	31	[1] 446, 193	646, 049	7, 591, 406	3, 783, 431	90, 089, 355	1, 051, 534	11, 188, 934
Total, 1926	27	[2] 543, 902	776, 854	8, 550, 848	5, 225, 647	94, 216, 430	8, 400, 429	15, 011, 520
Total, 1869–1927	-------	(3)	38, 601, 887	204, 857, 207	207, 926, 722	1, 367, 257, 449	28, 942, 765	304, 757, 063

[1] Includes 91,730 tons of old tailings sold to a smelter and 23,400 tons of old tailings treated in a volatilization plant.

[2] Includes 148,282 tons of old tailings sold to a smelter.

[3] Figures not available.

NOTE.—Total dividends, 1869–1927, $48,208,710.

The value of the metals from the Tintic district in 1927 was as follows: Gold, $646,049, against $776,854 in 1926; silver, $4,304,328, against $5,335,729; copper, $495,629, against $731,591; lead, $5,675,630, against $7,537,314; zinc, $67,298, against $630,032. The ore and old tailings sold or treated in the district in 1927 yielded on an average $25.08 in metals a ton, compared with $27.60 in 1926.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Utah, in 1927, by kinds of ore

Kind of ore	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	23	[1] 231, 299	20, 028. 40	2, 411, 307	2, 943, 601	5, 224, 615	----------
Copper	2	270	20. 12	4, 119	26, 498	----------	----------
Lead	18	206, 407	11, 097. 41	5, 096, 638	804, 213	83, 418, 629	----------
Lead-zinc	2	8, 217	106. 65	79, 342	9, 119	1, 446, 111	1, 051, 534
	[2] 31	446, 193	31, 252. 58	7, 591, 406	3, 783, 431	90, 089, 355	1, 051, 534

[1] Includes 91,730 tons of old tailings sold to a smelter and 23,400 tons of old tailings treated in a volatilization plant.

[2] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

There was a notable decrease in the metals produced by the Chief Consolidated properties—the Chief, Grand Central, Gemini, and Eureka Hill mines. The Chief Consolidated flotation plant at Eureka was operated several months in the early part of the year, after which the lower levels of the Chief mine were flooded and the supply of lead-zinc ore was cut off. The volatilization plant was operated on low-grade ore from the Eureka Lilly mine in the eastern part of the district and on a large quantity of low-grade tailings from the Eureka Hill dump. An article[5] on the flotation plant appeared in August, 1927.

The ore output of the Chief Consolidated Mining Co. in 1927 is given as 85,179 tons which includes ore from the property of the Plutus Mining Co., a separate incorporation controlled and worked by the Chief Consolidated Mining Co.; after transportation, sampling, and all operating charges were deducted the ore yielded a profit of $233,081. The Chief Consolidated Mining Co. has paid dividends regularly since February, 1913, but the company paid no dividends in 1927.

The combined metal contents of the ores from the Chief Consolidated properties, including the output of the Plutus mine, are given as follows in the company's annual report. The totals do not represent recovered metals but are assay contents of ores milled and ores shipped for smelting.

Metal contents (assay) of crude smelting ore and mill ore from Chief Consolidated property and Plutus mine, 1926–27

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Net returns	
							From smelter	After charges
	Dry tons	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*		
1926	159, 283	10, 152	2, 577, 530	1, 467, 029	31, 566, 687	14, 674, 965	$2, 537, 568	$564, 681
1927	85, 179	6, 763	1, 950, 586	539, 998	21, 261, 426	1, 060, 663	1, 772, 707	233, 081

Of the 85,179 tons of ore produced from the Plutus and Chief Consolidated properties, 59,211 tons of silver-lead ore and 17,730 tons of dry and siliceous ore were shipped for smelting; the custom flotation plant at Midvale received 352 tons of lead-zinc ore; and the concentrator at the Chief mine took 7,886 tons, of which 3,476 tons represented silver-lead ore, 409 tons dry gold and silver ore, and 4,001 tons zinc-lead ore. These ores averaged as follows: Gold, $1.63; silver, 22.90 ounces; lead in lead ores, 16.51 per cent; copper in dry ores, 1.56 per cent; lead in zinc-lead ores, 6.41 per cent; and zinc in zinc-lead ores, 12.19 per cent. All ores averaged $33.06 a ton in total value, which, after $15.26 was deducted for smelting, freight, and sampling, left a net value of $17.80 a ton. Development (in drifts, raises, and winzes) in the Chief Consolidated properties—Nos. 1, 3, and 5 shafts—aggregated 18,731 feet, and the company also did 9,265 feet of work in the Plutus mine. The report says:

> During the last quarter of the year conditions have very materially improved. The No. 1 mine is now on a self-sustaining basis, due to the fact that a lease has been given on this area which relieves the company from further large expense

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[5] Johnson, Homar L., Chief Consolidated Operates Successful Selective Flotation Plant: Eng. and Min. Jour., vol. 124, Aug. 13, 1927, p. 268.

in connection with its operation. The faulted sections in the mine have not so far been recovered to any great extent, but work in this connection is progressing. * * *

Some new ore has been discovered at the Grand Central mine during the past quarter, and we expect a small profit will result. * * *

The operations at the mill have been progressing in a very satisfactory manner. In recent research work we have discovered that we can now treat 90 per cent of our oxide ores both in the wet concentrator and volatilization plant at a great saving over present costs of treatment.

The Eagle & Blue Bell mine[6] produced 30,273 dry tons of low-grade smelting ore, including 13,514 tons of dump ore, containing 1,962 ounces of gold, 245,434 ounces of silver, 3,082,714 pounds of lead, and 89,644 pounds of copper, for all of which the net smelter returns were $147,905. The mine is opened by a vertical shaft 2,000 feet deep, and 4,664 feet of development was done in 1927. The gross income from operations was $262,587, operating expenses $232,312, and development $27,079. The net income after paying for development and interest was $2,301, and no regular dividends were paid from the year's earnings. The company's report says:

The shipments from the Eagle & Blue Bell were principally low-grade, and both the tonnage and the earnings show a decrease compared with 1926. Near the close of the year, however, an ore body was disclosed below the 1,875 level which may prove to be a continuation of the Eagle lead-silver channel which was highly profitable at a higher horizon.

The Victoria property of the Bingham Mines Co. adjoining the Eagle & Blue Bell mine southeast of Eureka was operated continuously and produced 29,390 tons of smelting ore containing 2,084 ounces of gold, 747,836 ounces of silver, 6,263,075 pounds of lead, and 196,017 pounds of copper, for which the smelter paid $469,949. About 6,000 feet of development was done in drifts, crosscuts, raises, and winzes. Nearly 89 per cent of the output was oxidized lead ore, about 8 per cent was oxidized copper ore, and the remainder was siliceous silver ore. The report of the Bingham Mines Co. for 1927 gives the following paragraph:

Besides a substantial increase in tonnage from the Victoria mine as compared with 1926, the ore was also of higher grade. Almost the entire output was lead-silver ore, obtained largely from the "135" and "373" workings.

The Tintic Standard and Iron Blossom mines[7] produced 127,822 dry tons of ore containing 5,860.54 ounces of gold, 3,295,086 ounces of silver, 43,687,436 pounds of lead, 742,783 pounds of copper, and 10,010 pounds of bismuth, which sold for $4,984,293. After smelter and freight charges of $1,966,083 were deducted the net smelter returns amounted to $3,018,210. The lead ore, 84,868 tons, contained on the average 0.04 ounce of gold and 27.93 ounces of silver to the ton, 0.21 per cent of copper, and 23.54 per cent of lead. The dry silver ore shipped, 361 tons, could be classified as a copper ore; it contained on the average 0.121 ounce of gold and 108.97 ounces of silver to the ton, 4.74 per cent of copper, and 2.21 per cent of lead. The siliceous ore, 42,593 tons, contained on the average 0.057 ounce of gold and 20.78 ounces of silver to the ton, 0.41 per cent of copper, 4.36 per cent of lead, and 0.01 per cent of bismuth. The mining cost amounted to $988,269. Deduction of general administrative expense, $105,610, and annual depreciation of plant and equipment, $45,999, from the operating income left a net operating income, before allowance for depletion and Federal taxes, of $1,924,332, which was increased to $2,270,605 by $346,273 nonoperating income. Deduction of $207,626 for State and county taxes and $192,483 for Federal income taxes—a total of $400,109—left a net income of $1,824,496. On December 31 the total current assets of the company were $4,215,756. Dividends of $1,959,955 were paid in 1927, making a total of $9,442,624 to date.

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[6] Bingham Mines Co. Nineteenth Ann. Rept., for year ended Dec. 31, 1927.

[7] Tintic Standard Mining Co. Ann. Rept. for year ended Dec. 31, 1927.

The company's report gives no details regarding ore reserves; it gives the output of the Tintic Standard mine to date—the ore shipped or milled with metal content—as follows: 1,129,939 tons of ore, 39,731.73 ounces of gold, 29,452,552 ounces of silver, 8,956,440 pounds of copper, and 289,272,311 pounds of lead. The report continues:

> Development work to the extent of 15,405.8 feet of drifting, 2,783 feet of raises, and 254 feet of sinking during the year was carried on in the Tintic Standard and Iron Blossom. At the Tintic Standard mine favorable results were obtained on the 800 level, about 1,100 feet north of No. 2 shaft. This ore is of the same type as the ore opened up 450 feet farther south on the 800 level, and it is expected the ore will be mined from one place to the other. The ore is a siliceous lead ore of less value than the average ore of the mine, with an average lead content of 13 per cent and 7 ounces of silver. On the 1,250 level, about 60° north 70 west of No. 2 shaft, an ore body of great importance was partially developed during December. Sufficient development has not been done to permit of estimates of the quantity of ore. The grade of ore is good, and it can be confidently stated that developed reserves of ore were increased during the year. * * *
>
> The control of the stock of the Iron King Consolidated Mining Co. was purchased in May, 1927. The property of this company consists of approximately 410 acres lying south of and adjoining the Tintic Standard Mining Co. property. Prospecting of the smaller properties was continued, but no ore of importance was developed.
>
> The Goshen Valley Railroad was sold to the Denver and Rio Grande Western Railroad Co. on June 1, 1927.

The Alaska mine was idle most of the year, but a small lot of lead-zinc ore was shipped to a custom concentrator at Midvale.

At the American Star mine, operated by the Bingham Mines Co., 738 feet of development was done in drifts, raises, and winzes on the 1,350-foot level; as this work disclosed only a continuation of the low-grade siliceous deposit, operations were suspended in August. A lessee produced 64 tons of siliceous silver ore that was shipped to Garfield for smelting.

The Empire Mines Co. shipped nearly 1,200 tons of siliceous silver ore and sulphide lead ore.

The Bullion Beck & Champion property, controlled by the United States Smelting, Refining & Mining Co., was not worked on company account in 1927, but the dumps were worked by lessees, who shipped nearly 4,000 tons of old tailings containing chiefly silver and lead.

From the Centennial-Eureka property, an old producer near Eureka, lessees shipped several hundred tons of dump ore, but no work was done in the mine.

The Gold Chain mine was prospected through workings on the property of the Empire Mines Co., and $13,172 was spent in development. One car of copper ore was shipped by a lessee.

The Iron Blossom mine near Silver City, controlled and operated by the Tintic Standard Mining Co., produced nearly 11,000 tons of ore, chiefly suphide lead ore and siliceous silver ore. The property has been a large producer since 1909 and was purchased by the Tintic Standard Mining Co. in 1925. The production, chiefly silver and lead, is included in the statement of the Tintic Standard Mining Co. (See p. 654.) The mine is opened by a vertical shaft 2,200 feet deep; work in 1927 consisted of 9,530 feet of drifting, 2,362 feet of raising, and 212 feet of sinking. No ore bodies of importance were developed on the 2,200-foot level, although production in the upper levels was maintained. The siliceous ore contained an oxidized bismuth mineral, and the company was paid for 10,010 pounds of bismuth. The output of the Iron Blossom mine to date is given as follows: 563,527 tons of ore, 91,626.68 ounces of gold, 14,901,288 ounces of silver, 6,858,825 pounds of copper, 60,528,618 pounds of lead, and 10,010 pounds of bismuth.

The Mammoth Mining Co., which again became a large producer in 1925, shipped in 1927 approximately 26,000 tons of material, chiefly siliceous silver ore, but including several thousand tons of oxidized lead ore. Although the mine, which is opened by a 2,100-foot vertical shaft, was a large producer of silver, copper, and lead in 1927, the output was considerably less than that in 1926. The company has paid $3,126,251 in dividends in the past, including those of 1926, but no dividends were paid in 1927.

A large quantity of old siliceous tailings (more than 82,000 tons) containing chiefly gold and silver was shipped from the Mammoth dump to the smelter at Garfield. This material contained on an average a little more gold than the first-class ore shipped in recent years from the new strike at the Mammoth mine.

The Plutus mine, controlled and operated by the Chief Consolidated Mining Co., shipped approximately 40,000 tons of oxidized silver-lead ore in 1927 and ranked second as a producer of silver and lead in the Tintic district and fifth as a producer of silver and eighth as a producer of lead in Utah. The Plutus Mining Co. paid $599,287 in dividends in 1927. The output of the Plutus mine is included in the statement (see p. 653) of the operating company, the Chief Consolidated Mining Co., from whose report the following paragraph is taken:

> At the Plutus property some new discoveries of ore have been made during the latter part of the past year. The development work is being gradually increased, and at the present time this mine has made quite definite progress as to tonnage and earnings. With the system of development now being carried on and the additional faces of ore discovered it would seem that henceforth the Plutus should be a steady earner of good profits.

A large quantity of low-grade tailings from the Eureka Hill dump was shipped to a smelter and more than 20,000 tons went to the volatilization plant of the Chief Consolidated Mining Co. at Eureka. Fume containing silver and lead recovered from these tailings, together with that recovered from ore from other properties, was shipped to the lead smelter at Midvale. Old tailings from the dump of the old Tintic mill at Silver City were also shipped for smelting.

Other producers in the Juab County part of the Tintic district in 1927 were the Little May, Dragon, Tintic Coalition, Silver Park, Showers, Swansea, and Undine mines. Work at the North Beck property, which is opened by two shafts, one 350 feet and the other 1,100 feet deep, consisted of 476 feet of sinking and 2,590 feet of drifting. At the Little May mine 703 feet of work was done and low-grade silver-lead ore containing 0.53 per cent of bismuth was encountered; however, returns on a test car of ore shipped did not justify mining.

In the eastern part of the Tintic district in Utah County the chief producers were the Tintic Standard (for review, see p. 654), North Lily, Eureka Lilly, Mountain View, Iron King, and Colorado Consolidated properties; two cars of oxidized lead ore were also shipped from the Yankee Consolidated mine.

The most interesting development in this section was the opening of a large body of ore in the North Lily mine, which was operated through a drift from the Tintic Standard property. More than 20,000 tons of oxidized silver-lead ore was shipped to the lead plant at International, and considerable work was done in opening the ore body and sinking a vertical shaft 1,200 feet. The chief ore mineral is anglesite, which has in places almost completely replaced the limestone. The construction of an aerial tramway 2,600 feet long was completed late in the year to deliver the ore from the shaft to the railway siding. Regular shipments of silver-lead ore were made through the Tintic Standard shaft after June, 1927, and early in 1928 increased shipments were being made over the tramway. The following paragraph is taken from the report of the Anaconda Copper Mining Co. for 1927:

> Development in the North Lily mine was continued during the year and has been most encouraging. A 4-compartment shaft was sunk to a depth of 954 feet. The shaft was connected with the 700 haulage level of the Tintic Standard Mining Co. early in January, 1928. Further shaft sinking and development work will be continued, together with surface improvements consisting of change house, warehouse, hoists and compressor with ore bins, and aerial tramway to connect with the Denver & Rio Grande Railway. In the course of development 21,486 tons of ore, averaging 25.5 per cent lead, 16.17 ounces of silver, and 0.1098 ounce of gold was extracted and shipped to International. The improvements should be completed by May 1, 1928, after which the mine will be ready for production.

The North Lily ore body[8] was found as a result of development planned after a careful study of all the geological data.

Partly through drifts run from the Tintic Standard property to the North Lily mine ore was also opened in the Eureka Lilly property, which is controlled by the Chief Consolidated Mining Co. The Eureka Lilly Mining Co. shipped several thousand tons of silver-lead ore to a smelter, and some low-grade oxidized ore was tested in the Chief Consolidated volatilization plant at Eureka. The report of the Chief Consolidated Mining Co. for 1927 says:

> The ore body in the Eureka Lilly mine, which was encountered several months ago, has developed into good size and grade from which a product is being shipped, the returns paying all development charges in addition to yielding a small monthly profit. This property is considered one of our most valuable holdings in the eastern part of the district, and we look for the future prosperity of the company to come from this section and from the Plutus mine. * * *

The Uncle Sam and May Day properties, owned by the Mountain View Mining Co., were worked by lessees who marketed about 1,600 tons of first-class lead ore, siliceous gold and silver ore, and gold ore.

The Iron King property was being further developed by the Tintic Standard Mining Co., and nearly 700 feet of work in shaft sinking and drifting was done. Shipments consisted of about 1,400 tons of ore of smelting grade that was chiefly valuable for its gold and silver.

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[8] Billingsley, Paul, North Lily Development in East Tintic: Min. and Met., vol. 3, April, 1927, p. 182.

The Tintic Standard Mining Co. also worked the Colorado Consolidated property and shipped about 500 tons of silver-lead ore and siliceous silver ore to various smelters.

At the North Standard property, which is opened by a 1,100-foot vertical shaft and 7,000 feet of drifts, work consisted of 1,900 feet of drifting on the 900-foot level. At the Eureka Standard Consolidated property more than 2,600 feet of work was done, chiefly in drifting. Extensive development was also in progress at the Silver Shield, Crown Point Consolidated, and Central Standard properties.

MORGAN COUNTY

Argenta district.—The Carbonate Hill mine near Peterson was operated by lessees, and several cars of carbonate lead ore were shipped to the lead plant at International. The Morgan Chief Mining Co. did 300 feet of tunnel work to prospect its property at greater depth.

PIUTE COUNTY

Mount Baldy district.—The Deer Trail mine near Marysvale, a large producer in the past, was idle in 1927. It was, however, being examined and sampled by the engineers of the United States Smelting, Refining & Mining Co.

Ohio district.—The Bully Boy mine was worked by the Utah Lead Co., and small lots of first-class ore and milling ore were shipped to Midvale for testing. A little work was done at the Gold Strike group of the Four Metals Mining Corporation.

SALT LAKE COUNTY

Salt Lake County, chiefly the Bingham district, has been the most important mining center of Utah since 1905. The value of the metal output of the county in 1927 was $47,737,954, or 65 per cent of the value of the output of the State. The decline in metal prices in 1927 resulted in a substantial decrease in the value of the output of copper, lead, and zinc, although there was an increase in the quantity of both copper and gold. The mines of Bingham have been large producers since the early days of mining. Their output increased greatly after the Utah Copper Co. started steam-shovel mining in 1907, and the value of the county's metal output in 1927 was three and a half times that of 1907.

Big and Little Cottonwood districts.—The production of the mines at Alta in Little Cottonwood Canyon and of those in Big Cottonwood Canyon has been combined in the following table:

Mine production of gold, silver, copper, lead, and zinc in Big Cottonwood and Little Cottonwood mining districts, Utah, 1926–27, and total, 1867–1927

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1926	15	10, 907	$5, 096	206, 498	449, 069	3, 194, 890	360, 270	$479, 433
1927	11	5, 181	5, 085	148, 115	249, 337	2, 017, 283	1, 666	248, 925
Total, 1867-1927	-------	601, 546	563, 412	16, 359, 852	15, 607, 709	230, 828, 209	683, 991	33, 190, 508

In the Big Cottonwood district four lode mines produced 3,366 tons of ore which yielded $1,650 in gold, 91,834 ounces of silver, 177,322 pounds of copper, and 1,519,737 pounds of lead, valued in all at $172,693, or $51.31 in metals a ton. The chief producer was the Cardiff mine, from which about 3,000 tons of copper-lead ore was shipped to a smelter; the ore is hauled 18 miles west in Big Cottonwood Canyon to Atwood. In 1927 nearly 1,000 feet of development was done in drifts, winzes, and raises, and the company paid $50,000 in dividends, making a total of $1,075,000 to date. The opening of a new ore shoot along the overthrust contact was reported in December. The Alta Tunnel & Transportation Co., leasing the Prince of Wales mine, shipped several cars of oxidized lead ore for smelting and also treated a small quantity of ore in an experimental concentration mill. A new 50-ton concentration plant was completed late in 1927, but it could not be operated on account of the severe weather. The mine is opened by a tunnel 3,500 feet long, 3,000 feet of drifts, a 425-foot vertical raise, and an inclined winze 330 feet deep; several hundred feet of work was done in 1927. The old Maxfield mine, which is opened by about 27,000 feet of drifts and tunnels, produced one car of silver-lead concentrate after a 5-ton jig concentrator was constructed in May. Development was continued throughout the year. An article[9] giving the interesting features of this old producing mine was published in February. Two small lots of ore chiefly valuable for gold and silver were shipped from the Lake Blanche mine.

In the Little Cottonwood district seven lode mines produced 1,815 tons of ore, which yielded $3,435 in gold, 56,281 ounces of silver, 72,015 pounds of copper, 497,546 pounds of lead, and 1,666 pounds of zinc, valued in all at $76,232, or $42 in metals a ton; the output was only about one-third that of 1926. Most of the ore was shipped from the Mineral Veins Coalition, Michigan-Utah, and Columbus Rexall properties. The Columbus and Flagstaff properties, operated by the Mineral Veins Coalition Mines Co., produced nearly 800 tons of smelting ore that was chiefly sulphide lead and copper material; a small lot of lead-zinc ore was also tested at the Midvale flotation plant. At the Michigan-Utah property the output of silver-lead ore was much less than that of 1926, as a snowslide destroyed the aerial tramway and no shipments were made until June. The Columbus Rexall mine produced only about 300 tons of silver-lead ore. The Alta Merger group was practically idle, but one lot (39 tons) of silver-lead ore was shipped to the Murray lead plant. Operations were confined to prospecting in the west side of the property off the Dwyer drain and transportation tunnel, but no first-class ore was discovered. One car of carbonate lead ore was marketed from the West Toledo mine; this mine has produced specimens of crystalline cerussite of exceptional size and beauty. Two lots of silver ore were shipped from the Little Rose mine. About 200 feet of tunnel work was done at the Hellgate property. No ore was shipped from the Emma mine, but arrangements were being made for further development of the property.

Bingham or West Mountain district.—In 1927 the mines of the Bingham district produced ore yielding on the average $3.22 in metals a ton, against $3.53 a ton in 1926. Shipments of first-class ore amounted to 133,909 tons as compared with 141,547 tons in 1926; the output of concentrating ore was 14,385,212 tons, against 14,379,925 tons in 1926; and the quantity of concentrates produced was 677,689 tons, against 904,168 tons in 1926, the decrease being due to the dropping of pyrite. The ore of smelting grade, amounting to 133,909 tons, consisted chiefly of copper and lead sulphides and a little siliceous gold ore; it yielded 15,133.96 ounces of gold, 858,964 ounces of silver, 6,840,167 pounds of copper, and 20,821,657 pounds of lead, valued in all at $3,007,706, or $22.46 a ton. The milling ore (14,385,212 tons) produced 677,689 tons of copper, lead, zinc, and iron concentrates yielding 109,031.05 ounces of gold, 2,723,099 ounces of silver, 237,031,907 pounds of copper, 90,193,530 pounds of lead, and 49,097,827 pounds of zinc, valued in all at $43,673,502, or $64.44 in metals to a ton of concentrates. In addition, copper precipitates, recovered from mine water and from leaching of ore in place, yielded 6,046,915 pounds of copper and 21 ounces of silver, valued together at $792,158.

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[9] Hoskins, Lloyd W., Comprehensive Description of Famous Old Maxfield Mine: Salt Lake Min. Rev., vol. 28, Feb. 28, 1927, p. 9.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Utah, 1926–27, and total, 1865–1927

Year	Mines producing	Ore	Gold	Silver	Copper[1]	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1926	26	14, 521, 472	$2, 490, 239	3, 528, 460	[2] 248, 975, 102	109, 993, 099	50, 762, 818	$52, 155, 171
1927	20	14, 519, 121	2, 566, 718	[3] 3, 582, 084	[3] 249, 918, 989	111, 015, 187	49, 097, 827	47, 473, 366
Total, 1865–1927	-------	(4)	[5] 49, 535, 512	[5] 71, 490, 760	3, 395, 694, 945	1, 759, 487, 752	195, 952, 844	790, 580, 816

[1] Includes copper saved from precipitates.
[2] Includes 6,187,049 pounds of copper saved from precipitates.
[3] Includes 21 ounces of silver and 6,046,915 pounds of copper saved from precipitates.
[4] Figures not available.
[5] Includes placer production.

NOTE.—Total dividends, 1865–1927, $170,747,093.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Utah, in 1927, by kinds of ore

Kind of ore	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	5	1, 551	1, 294. 57	11, 769	56, 103	25, 066	-----------
Copper	12	13, 877, 374	98, 468. 35	[1] 1, 120, 746	[1] 244, 104, 442	221, 000	-----------
Lead	15	66, 484	4, 674. 04	610, 791	1, 011, 505	20, 575, 591	-----------
Copper-lead	1	70, 736	943. 77	85, 140	2, 040, 348	2, 478, 688	-----------
Lead-zinc	12	502, 976	18, 784. 28	1, 753, 638	2, 706, 591	87, 714, 842	49, 097, 827
	[2] 20	14, 519, 121	124, 165. 01	3, 582, 084	249, 918, 989	111, 015, 187	49, 097, 827

[1] Includes 21 ounces of silver and 6,046,915 pounds of copper saved from precipitates.
[2] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

During 1927 the Utah Copper Co.[10] produced 37,840 tons of ore a day, or a total of 13,811,500 tons of ore that contained 0.98 per cent of copper. This ore was mined by electric shovels and treated at the Magna and Arthur flotation plants. Metals recovered from concentrates during 1927, together with 713,751 pounds of copper precipitated from mine waters, amounted to 233,002,661 pounds of copper, 795,888 ounces of silver, and 89,303.28 ounces of gold, valued in all at $32,738,904. In addition, leasers produced more than 21,000 tons of lead-zinc ore, copper ore, and lead ore. The concentrate shipped to the smelter averaged 25.10 per cent of copper in 1927, against 17.07 per cent in 1926.

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[10] Utah Copper Co. Twenty-third Ann. Rept., for year ended Dec. 31, 1927.

After all operating charges of production, including the cost of marketing refined copper, were deducted the direct profits from mining operations for the year were $13,718,088. Indirect earnings for the period, accruing as miscellaneous income incident to operations, amounted to $3,264,624, which made a total income of $16,982,711. The audit report shows deductions for other charges, including Federal income-tax accruals, depreciation of plant and equipment, and obsolescence or retirement of property, aggregating $2,395,679, leaving a net income carried to surplus account of $14,587,032, or approximately $8.98 per share of capital stock outstanding.

Dividends paid to stockholders in 1927 amounted to $6 a share, or a total of $9,746,940, of which about one-third was capital distribution. The aggregate distributions paid to stockholders up to December 31, 1927, were $156,995,382. A revised calculation of developed ore reserves on December 31, 1927, as they will be mined, gave 572,000,000 tons of milling ore carrying approximately 1.10 per cent of copper. The total ore mined to date was 159,586,151 tons. Therefore, the total ore mined and to be mined from the beginning of mining to the exhaustion of the estimated reserves approximates 732,000,000 tons. A short article[11] on the mine appeared in August.

The mining cost for a ton of ore milled, including a proper apportionment of fixed general charges (but not including Federal taxes and depreciation), was 37.34 cents, of which 19.34 cents represents stripping charges. This amount covered the cost of all stripping actually removed during the year and an apportionment of similar charges, previously deferred. The actual direct mining cost of all ore was 18 cents a ton, of which 12.91 cents represents all mine charges; the balance—5.09 cents—represents fixed and general charges.

The ore treated at the Magna and Arthur plants was 6,819,800 and 6,991,700 tons, respectively, a total of 13,811,500 tons, equivalent to a daily average of 37,840 tons. The average content of the ore was 0.98 per cent of copper as compared with 1.01 per cent of copper in 1926, and the average recovery in the form of concentrates was 89.12 per cent as compared with 87.01 per cent in 1926. The average milling cost was 45 cents a ton, a decrease of 3 cents from the cost of 1926.

The average cost per net pound of copper, depreciation of plant and equipment and all fixed and general expenses being included and gold, silver, and miscellaneous earnings credited, was 7.54 cents, compared with 7.94 cents, computed on the same basis, for 1926. The value of the gold and silver recovered and the miscellaneous earnings amounted to 1.16 cents per pound of copper as compared with 1.36 cents for 1926. The report continues:

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[11] Utah, Premier Copper Mine: Eng. and Min. Jour., vol. 124, Aug. 20, 1927, p. 281.

Mining operations were continued as in recent years in the upper portions of the ore body, as the ore remaining in the levels above the elevation of the original pit is producing all of the tonnage. * * *

There were no major improvements installed at the mine during the year. The only new equipment acquired was an 85-ton combination trolley storage-battery locomotive. * * *

The concentrates shipped to the smelter contained 240,964,666 gross pounds of copper, the average grade being 25.10 per cent as compared with 244,026,905 gross pounds and 17.07 per cent, respectively, for the year 1926. * * *

In the past, progress in production has been largely the direct reflection of mechanical improvements at either the mine or the mills. The report for 1926 stated that the plants had a capacity for handling 50,000 tons per day when treating ores of an average grade milled during the then preceding two years. That capacity has been demonstrated for short periods and could be maintained indefinitely.

When costs are calculated on the same basis as in previous years, the cost per pound of producing copper in 1927 is the lowest in the company's history—the previous banner year being 1915, when the ore contained 28.5 pounds of copper per ton as compared with 19.6 pounds per ton in 1927. The record is the more signal because, in the period under review, wages increased approximately 50 per cent, the cost of supplies 68 per cent, and taxes, as a whole, 308 per cent over the rates obtaining in 1915.

In the decade 1918 to 1927 the company milled 92,365,451 tons of ore; its net production of refined copper was 797,720 tons. Both the Magna and Arthur mills have been completely converted to straight flotation plants using an alkaline circuit. In order to raise the grade of copper concentrate and at the same time reduce the cost of smelting, a large part of the pyrite was being regularly dropped at both mills.

The output of ore from the United States Smelting, Refining & Mining Co.'s mines[12] at Bingham, including the Niagara property, amounted to 201,699 tons, an increase of 4,271 tons over that of 1926. With the exception of a little more than 4,000 tons, the entire output was lead-zinc ore treated at the new flotation plant at Midvale, which separates the galena-sphalerite-pyrite ore into lead, zinc, and iron concentrates. Both the lead and the iron products were treated locally at the Midvale lead smelter and the zinc concentrate was shipped to Amarillo, Tex., and Great Falls, Mont. Direct smelting ore consisted of several thousand tons of first-class lead ore and copper ore. The property ranked second in the production of zinc, fifth in lead, and third in gold in Utah in 1927. The Old Jordan-Telegraph-Last Chance group and the Niagara mine are opened at depth through the Niagara and Butterfield tunnels. In the former property approximately 11,000 feet of drifting and raising was done in 1927 and in the Niagara mine 1,600 feet was done. Details regarding the developed ore reserves are not published in the company's printed annual report.

The Utah-Delaware Mining Co. worked the Highland Boy and Yampa groups at the head of Carr Fork and produced approximately 198,000 tons of ore, which was mainly lead-zinc ore treated at the custom flotation plant at International. About 25 per cent of the mine output was first-class copper ore and lead ore smelted at the copper and lead plants at International. An aerial tramway takes the company ore, as well as some custom material from Bingham, to the International mill and smelter. Since the lawsuit with the Utah-Apex Mining Co. was terminated in 1923 the property has been controlled by the International Smelting Co.; details regarding ore reserves and costs are not made public. The property ranked third in the production of zinc and fourth in copper, gold, and lead in Utah in 1927. The mine is extensively developed, and in 1927 the work consisted of 11,343 feet of drifting, 4,210 feet of crosscuts, and 5,126 feet of raises. According to the printed report of the Anaconda Copper Mining Co., the Utah-Delaware mine produced 1,856 tons of copper ore and 148,991 tons of lead-zinc ore. In addition, 30,233 tons of copper ore and 17,873 tons of lead-zinc ore were produced by lessees operating on a royalty basis.

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[12] United States Smelting, Refining & Mining Co. Ann. Rept. for 1927.

The Utah-Apex Mining Co. decreased its output of first-class smelting ore nearly 50 per cent in 1927 but increased its milling product about 35 per cent as a result of improvements and additions at the mill. The milling product consisted of lead-zinc ore that was reduced to lead concentrate and zinc concentrate and copper-lead ore that was separated into copper and lead products. The crude smelting ore was chiefly sulphide copper ore of good grade from a new deposit recently found at the property. According to a report to the Bureau of Mines for the calendar year 1927, the company produced 227,936 tons of ore, of which 36,200 tons was shipped direct to the smelters and 191,736 tons (122,285 tons of lead-zinc ore and 69,451 tons of copper-lead ore) was milled. The copper concentrate, 5,191 tons, contained 596.49 ounces of gold, 42,003 ounces of silver, and 1,902,932 pounds of copper. The lead concentrate, 21,960 tons, contained 3,185.23 ounces of gold, 383,861 ounces of silver, 1,673,264 pounds of copper, and 23,020,562 pounds of lead. The zinc concentrate, 8,477 tons, contained 212.88 ounces of gold, 16,878 ounces of silver, 193,022 pounds of copper, 267,835 pounds of lead, and 8,450,189 pounds of zinc. The first-class smelting ore consisted of 29,925 tons of sulphide copper ore (containing 2,726.69 ounces of gold, 107,301 ounces of silver, and 3,148,970 pounds of copper) and 6,275 tons of sulphide lead ore (containing 275.78 ounces of gold, 33,392 ounces of silver, 146,064 pounds of copper, and 3,218,442 pounds of lead); the lead ore also contained 948,594 pounds of zinc, part of which was saved by flotation.

The interesting features of the year were the increase in copper in both crude ore and concentrates and the saving of copper concentrate and lead concentrate from copper-lead ore, due to additions to the flotation plant. The company ranked second in the production of copper, fifth in zinc, and sixth in lead and gold in Utah in 1927. The mine is developed by two vertical shafts, 1,400 and 2,500 feet deep, respectively, a main winze 500 feet deep, and various drifts, raises, and tunnels. In 1927 development consisted of 17,984 feet of drifting, 1,576 feet of raises, and 386 feet of winzes, as well as 25,375 cubic feet of station and pocket cutting. The improved flotation plant has a capacity of 800 tons of ore a day, and the ore contains chiefly sphalerite, chalcopyrite, galena, and bornite. The large quantity of chalcopyrite is notable, especially as the property is close to the Utah Copper mine where chalcocite predominates. Articles[13] describing the mill were published early in 1927; the ore reserves were said to be 105,200 tons of lead-zinc ore and 72,200 tons of copper ore. The following notes are taken from the company's report for the fiscal year ended August 31, 1927:

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[13] Martin, Gail, New Utah-Apex Flotation Plant: Eng. and Min. Jour., vol. 123, Jan. 8, 1927, p. 64; Gayford, Ernest, Evolution of Milling Methods at the Utah-Apex Mine: Min. Cong. Jour., February, 1927, p. 128.

> Improvements in equipment and mining methods enabled the management during the past year to reduce mining costs considerably; but the materially lower metal prices, the extremely erratic and irregular occurrence of ore bodies, the increased pumping expense at greater depth, and the low-grade ore mined were not offset by these improvements. * * *
>
> The additions to the milling plant which were started during the summer of last year were completed in November, 1926. These included a new coarse crushing plant, a new thickening and filtering plant, in addition to fine grinding and flotation equipment to handle 300 tons of lead-copper ore. The operation of this new equipment has been very satisfactory, and the results in the lead-copper section are fully up to expectations. The introduction of up-to-date milling equipment and improvements made in the flotation machinery and practice have contributed not only to better metallurgical results and reduction of operating costs, but it may be fairly assumed that without the present mining facilities it would have been impossible to operate without loss on the bulk of the ore mined. * * *
>
> In the development of the lower portions of the mine the 2,400-50 winze has been extended from the 2,500 level to the 2,700 level. Four ore bodies are now being worked between these levels. Development work on the 2,700 level has been in progress during the past three months. A crosscut has been driven from the winze to the Yampa vein, and drifts are now being driven along the vein. Lead ore has been encountered recently in one of these drifts, and copper ore of commercial grade has been found in another.
>
> The most important development during the past year has been the discovery of a new ore body on the Yampa vein in the western part of the property. The ore contains lead and zinc above average grade. It was first found on the 1,500 level and has now been opened up on two levels above, approximately 100 feet apart. The 1,800 level is being driven into this territory now, but no ore of commercial quality has been found here as yet.
>
> Exploration and development work done during the year opened up several new ore deposits, and estimated ore reserves, as of August 31, 1927, are as follows: Crude copper shipping ore, 18,000 tons assaying 4 to 5 per cent of copper; lead-copper milling ore, 45,000 tons assaying 4 to 5 per cent of copper and 2 to 3 per cent of lead; and lead-zinc milling ore, 80,000 tons assaying 7 to 8 per cent of lead and 5 to 6 per cent of zinc. It will be noted that the estimated ore reserves at the close of this year are somewhat higher than the estimated ore reserves at the close of the preceding year, but the estimated lead content is lower.

For the fiscal year ended August 31, 1927, the company received $2,491,897 from the sale of ore, from royalties, etc. Mining, milling, and development cost $1,776,400; after general expenses were paid a balance of $367,202 was left before providing for depletion and the Federal income tax.

The Bingham Mines Co.[14] continued to operate the Dalton & Lark group at Lark, but lessees worked the company's Commercial mine at Bingham. A record tonnage was shipped notwithstanding rather low metal prices. The output of the Commercial mine was comparatively small, consisting of 221 tons of sulphide copper ore of smelting grade. The Dalton & Lark property produced 39,672 tons of material, including lease ore, which was chiefly sulphide lead ore; about 3,500 tons of the output was lead-zinc ore shipped to International for milling. The property at Lark, which has been producing regularly since 1901, is extensively developed; 4,478 feet of work in drifts, crosscuts, raises, and winzes was done in 1927. The company paid $200,000 in dividends in 1927 from the profits of its operations at Lark, Bingham, and Eureka, a total of $1,192,375 to date. The output from the company's mines near Bingham is given as follows:

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[14] Bingham Mines Co. Nineteenth Ann. Rept., for year ended Dec. 31, 1927.

Mine production of gold, silver, copper, lead, and zinc from mines of the Bingham Mines Co., Bingham, Utah, in 1927

Mine	Ore	Gold	Silver	Copper	Lead	Zinc	Smelter returns
	Dry tons	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*	
Dalton & Lark	39, 672	1, 061	413, 564	909, 233	9, 223, 858	1, 132, 750	$390, 965
Commercial	221	27	771	19, 334	----------	----------	1, 844
	39, 893	1, 088	414, 335	928, 567	9, 223, 858	1, 132, 750	392, 809

The company received $1,332,685 from ore shipments, royalties, etc., the net income was $309,459, and the surplus at the end of 1927 was $1,997,952.

The Winamuck & Dixon property, also controlled by the Bingham Mines Co., was operated by lessees. Shipments consisted of 497 tons of silver-lead ore and a small lot of copper precipitates. No development was carried on at the Farragut property, but publication for patent on both the North and South groups was completed with no adverse claims, and the necessary papers were filed with the Government for obtaining patent to the ground.

Leaching of ore in place continued during 1927 at the property of the Ohio Copper Co.[15] through the use of slightly acidified water. The output of copper recovered from precipitates in 1927 was 4,825,587 pounds as compared with 4,963,761 pounds in 1926. The cost was 10.2548 cents a pound, compared with 8.9985 cents a pound in 1926. The net profits, after deduction of fixed charges, taxes, adjustments, etc., but not depreciation and depletion, amounted to $46,454, compared with $140,261 in 1926. Development consisted of 1,700 feet in the South crosscut from the Mascotte level, 784 feet of drifts, and 1,757 feet of diamond drill holes. The company's report continues:

> The purpose of the development campaign was to hunt for ore bodies in limestone beds which were thought to underlie the quartzite exposed in Ohio workings. Exceedingly valuable ore bodies had been mined in these limestones in the neighboring mines in the Bingham district. A study of the geology indicated that there was an excellent chance of finding equally valuable ore bodies in the Ohio property. * * *
>
> The first step in the development consisted in running a long crosscut south from the Mascotte tunnel and in driving three diamond drill holes from this crosscut. * * * It proved:
>
> 1. That the northern two-thirds of the Ohio property is underlain by the ore bearing limestones, as had been expected. The upper limestone is only 200 feet below the Mascotte level in the southern part of this area, just north of a large porphyry dike, while at the north end of the property the limestones will be 2,000 feet below the Mascotte level.
> 2. That these limestones are highly mineralized. All of the drill holes in limestone showed large amounts of iron sulphide, and the third drill hole developed notable amounts of lead, silver, and gold. Several drill samples, each representing 2 to 5 feet in depth, assayed from 6 to 12.5 per cent of lead, from 1 to 3.5 ounces of silver, and from $5 to $11.50 in gold. It is impossible to estimate any tonnage of ore from one drill hole, but the character and intensity of mineralization make it virtually certain that very valuable ore bodies will be found in the limestone in this northern portion of the Ohio property.
> 3. That in the southern part of the property a relatively small body of limestone and quartzite entirely engulfed in porphyry comes to and above the

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[15] Ohio Copper Co. of Utah Ann. Rept. for year ended Dec. 31, 1927.

Mascotte tunnel level. A drill hole showed low-grade mineralization in one of these limestone beds just below the Mascotte level.

The second step in the development, which started on the completion of the diamond drilling in July, 1927, and is still under way, has for its purpose the opening up of the ore body found by drilling 400 feet below the Mascotte level near the center of the Ohio property, and the prospecting of the smaller limestone bodies on the Mascotte level in the southern portion of the property.

The ore output of the Utah Metal & Tunnel Co. was approximately five times that of 1926. Shipments consisted of more than 1,000 tons of first-class copper ore and lead ore marketed for smelting and about 10,000 tons of lead-zinc ore which was carried by an aerial tramway to International for milling. Development in 1927 consisted of 4,357 feet of work as compared with 10,000 feet in 1926. The company received $145,079 from the sale of ore and from other sources of income but paid no dividends in 1927. The operating expenses were $188,564, and $70,574 was spent for development. The net loss, including charges for depletion and depreciation, was $125,875. The financial statement of the company gives the output for 1927 as follows: 11,802 tons of ore containing 1,049.81 ounces of gold, 52,986 ounces of silver, 130,110 pounds of copper, 1,374,790 pounds of lead, and 596,490 pounds of zinc.

The Montana Bingham property, including the Tiewaukee mine, controlled by the Bingham Mines Co., produced 1,439 tons of ore that was a mixture of first-class siliceous silver ore, oxidized lead ore, and several hundred tons of lead-zinc milling ore. In addition to the metals recovered from crude ore and concentrates, about 200,000 pounds of copper was recovered from mine-water precipitates. The company received $32,351 from the sale of 1,439 dry tons of ore and 162 tons of copper precipitates. The ore contained 64.80 ounces of gold, 10,401 ounces of silver, 8,307 pounds of copper, 346,711 pounds of lead, and 93,305 pounds of zinc. Development in drifts, raises, and winzes consisted of 2,387 feet of work, which cost $18,004. The report of the Montana Bingham Consolidated Mining Co. for 1927 gives the following paragraph:

> Operations were carried on throughout the year in a limited way, the development work being confined to the Tiewaukee property, principally above No. 3 tunnel, which has its portal in Tiewaukee gulch. A raise from this tunnel connected with the old workings of the Caledonia mine, and the developments demonstrate that the ore body above the No. 3 tunnel is a continuation of the Caledonia deposit. The ore, lead-silver and lead-zinc, was found in a strong northeast-southwest fissure zone.

A considerably increased output of ore was mined from the New England property owned by the Bingham Metals Co. Most of the material was first-class silver-lead ore and siliceous gold ore; the remainder was lead-zinc ore that was treated by flotation at Midvale. The mine is opened by an inclined shaft and six levels, and in 1927 more than 2,400 feet of work was done in drifts, crosscuts, raises, and winzes. The ore is either hauled 1½ miles to the railroad siding at the Utah-Apex mine or 2 miles through the Niagara tunnel to the ore bins of the United States Smelting, Refining & Mining Co. at Copperfield.

The output of the Park-Bingham Mining Co., which controls the old Silver Shield and Bully Boy properties, consisted of about 10,000 tons of ore, most of which was lead-zinc ore milled at Midvale. Considerable first-class lead ore was shipped for smelting, but the chief product from the custom mill ore was silver-lead concentrate, as the mill heads contain considerably more lead than zinc; the output of recovered lead is approximately four times that of zinc. Although the property was a large producer of lead, it is still chiefly in the development stage, and considerable work was done in 1927 in raises on fissures developed through drifts from the Butterfield tunnel of the United States Smelting, Refining & Mining Co. The company shipped 183 cars of ore from March to December and was said to have developed ore reserves equal to the quantity of ore shipped in 1927.

Three cars of low-grade ore containing gold and silver were shipped from the Extra Session property at Lark operated by the Lead Silver Mines Co. Development was continued throughout 1927, and in December the mine was sold to Hogle & Beeson and the name changed to the Bingham Prospect Mining Co. High-grade ore was opened later, and the mine became a regular shipper early in 1928.

Several lots of ore containing chiefly gold, silver, and lead were shipped by lessees from the Queen (Lavagnino) mine. Miscellaneous lots of ore were also shipped from the Barstow and Floor N. properties.

At Garfield the American Smelting & Refining Co. operated its copper smelter, consisting of reverberatories and converters, on custom material from Utah, California, Nevada, and Colorado; the material was chiefly copper concentrate from the mills of the Utah Copper Co. Shipments of copper bullion averaged more than 22,000,000 pounds a month.

Smelter district (*Midvale and Murray*).—The output of the Smelter district in 1927 consisted of a small quantity of ore and slag, some old tailings, and concentrates recovered from a clean-up around the site of the old wet concentration mill and electrostatic plant formerly at Midvale.

At Midvale the lead smelter of the United States Smelting, Refining & Mining Co.[16] treated custom ore and concentrates, producing 48,067 tons of lead bullion, a decrease of 1,548 tons as compared with 1926. The smelter is equipped with seven blast furnaces, of which five were active in 1927. In addition to producing lead bullion and matte, the smelter has special plants for the recovery of refined arsenic and cadmium. In the last nine years the works have produced 354,248 tons of lead bullion, an average of 39,361 tons a year.

The new flotation plant treated an average of 800 tons of lead-zinc ore a day, and it is probable that a larger tonnage could be treated should the market warrant it. From 1919 to 1927 this new mill and the old concentration mill have treated 1,485,617 tons of ore, an average of 165,069 tons a year for the nine years.

At Murray the American Smelting & Refining Co. operated its lead plant, running about five of the eight blast furnaces. This plant has been in operation for more than 20 years; the development of smelting processes has, however, caused many changes in recent years, particularly in the roasting devices. Lead bullion is shipped East for refining, matte to the company's copper plant at Garfield, and arsenic dust to Colorado. Although Salt Lake City is the center for a large smelting industry, no refined manufactured products are made locally, as both the copper bullion and lead bullion are refined and the zinc concentrates are smelted in other States.

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[16] United States Smelting, Refining & Mining Co. Ann. Rept. for 1927.

SUMMIT AND WASATCH COUNTIES

The Blue Ledge and Snake Creek districts in Wasatch County and the Uintah district in Summit County represent the producing area of the Park City region.

Mine production of gold, silver, copper, lead, and zinc in Park City mining region, Utah, 1926–27, and total, 1870–1927

Year	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1926	14	[1] 693, 629	$393, 271	6, 620, 817	2, 279, 281	71, 819, 276	33, 036, 777	$13, 067, 061
1927	12	[2] 706, 351	667, 649	6, 935, 267	2, 595, 419	82, 805, 275	44, 856, 214	13, 027, 474
Total, 1870–1927	-------	([3])	6, 718, 230	182, 285, 848	47, 219, 918	1, 728, 827, 531	189, 721, 557	254, 678, 115

[1] Includes 211,465 tons of old tailings.
[2] Includes 147,721 tons of old tailings.
[3] Figures not available.

NOTE.—Total dividends, 1870–1927, $56, 971, 717.

Mine production of gold, silver, copper, lead, and zinc in Park City mining region, Utah, in 1927, by kinds of ore

Kind of ore	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	2	6, 225	318. 10	129, 482	40, 103	219, 000	------------
Lead	7	[1] 27, 054	1, 337. 81	1, 221, 189	616, 126	13, 822, 315	------------
Lead-zinc	10	[2] 673, 072	30, 641. 62	5, 584, 596	1, 939, 190	68, 763, 960	44, 856, 214
	[3] 12	706, 351	32, 297. 53	6, 935, 267	2, 595, 419	82, 805, 275	44, 856, 214

[1] Includes 367 tons of old tailings sold to a smelter.
[2] Includes 147,354 tons of old tailings concentrated.
[3] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

The output of the Park City region came chiefly from the Park Utah mine at Keetley (which is worked through the Ontario drain tunnel), the Silver King Coalition mine in Woodside Gulch, the Daly West and Daly Judge mines in Empire Canyon, and the Ontario mine in Ontario Canyon. The chief milling now done in the region is that at the Silver King Coalition mill, which is an 800-ton flotation plant. The Judge mill treats ore from the Daly Judge and Daly West mines, but it is still primarily a wet concentration plant and makes a lead concentrate shipped for smelting and a zinc-iron middling that is re-treated at the International custom flotation plant.

The Silver King Coalition Mines Co.[17] produced 20,490 tons of first-class ore (including 173 tons of lease ore) which was shipped for direct smelting and 139,164 tons of second-class or mill ore, a total of 159,654 tons. There was an increase in the output of both classes of ore, especially in the mill ore, resulting in a general increase in the recovered gold, silver, copper, lead, and zinc. The cost of production was $1,648,628, or $10.33 a ton, for mining, milling, and other charges, including depreciation ($72,240). Taxes amounted to $204,604, making the total expenditure $1,853,232. The net operating profit in 1927 was $1,388,148. The milling ore yielded 21,515 tons of lead concentrate and 9,795 tons of zinc concentrate. The accompanying table gives the average metal contents of all products from the property:

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[17] Silver King Coalition Mines Co. Ann. Rept. for year ended Dec. 31, 1927.

Gold, silver, copper, lead, and zinc contained in products of Silver King Coalition mine, Utah, in 1927

Kind of material	Gold		Silver		Copper		Lead		Zinc		Net smelter returns
	Total	Per ton	Total	Per ton	Total	Percentage	Total	Percentage	Total	Percentage	
	Ounces	*Ounce*	*Ounces*	*Ounces*	*Pounds*		*Pounds*		*Pounds*		
First-class ore	1,041.35	0.0513	1,057,928	52.07	668,708	1.65	12,456,277	30.66	----------	-----	$1,083,848
Lead concentrate	2,021.22	.0939	1,233,114	57.31	600,709	1.40	24,216,669	56.28	----------	-----	1,787,448
Zinc concentrate	198.10	.0202	135,942	13.88	97,746	.50	1,329,664	6.79	10,318,932	52.67	310,688
Lessees' ore	50.15	.2899	11,272	65.16	5,373	1.55	126,223	36.48	----------	-----	3,834
	3,310.82	--------	2,438,256	--------	1,372,536	-----	38,128,833	-----	10,318,932	-----	3,185,818

The Silver King Coalition mill, which formerly used tables and wet concentration, was changed late in 1927 to an all-flotation plant making lead concentrate and zinc concentrate. Tables were used only during the first part of the year to concentrate a small quantity of carbonate ore. The capacity of the mill was increased to treat a maximum of 800 tons a day but averaged only about 400 tons a day. During the year $188,494 was spent in development (18,496 feet of drifting, raising, and sinking); dividends of $1,338,094 were paid, making a total of $21,218,639 to date. The amount paid in dividends in 1927 was the largest disbursement since the organization of the present company in 1907. A dividend of $304,985 was also declared payable on January 2, 1928. The report says:

> After deductions for smelting and the freight on the ore from Park City to the smelter, the company received $3,185,818 from ore sales. Interest, rentals, and all other incomes amounted to $55,563, making a total income for the year of $3,241,381. * * *
>
> The development and exploration work done during the year conclusively demonstrates the continuity of the ore bodies. To economically develop the property at greater depth excavation for a new underground hoisting unit was completed during the year, together with the installation of hoisting machinery and equipment, and at the present time the work of shaft sinking and extending laterals therefrom to undeveloped ground is being done.
>
> To offset the decline in metal prices, as compared with the previous year, some increase was made in production. This increase, as well as improved milling practices at your mill and a reduction in cost of production, enabled your company, after paying all operating expenses, including expenditures for development and exploration work, property purchases, betterments, and new equipment, to meet dividend requirements of $1.10 per share. * * *
>
> The change in the method of treating mill ores simplifies mill operation and results in a reduction of mill operating costs. The flotation process will further improve metal extraction and the separation of lead and zinc concentrate products and will show a marked increase in the metal contents of lead concentrates

shipped to the smelter, with a corresponding reduction of total smelter costs for metals produced.

During the year your company expended for additional ground and stock in other companies the sum of $143,576. At present your company's holdings are approximately 98.5 per cent of the issued capital stock of the Silver King Consolidated Mining Co.

Operations at the property were continuous and uniform throughout the year. The extensive development and exploration campaign has revealed additional large ore reserves, so that the stockholders can reasonably expect profitable operations from the property for some time to come.

At the end of the year the company had a balance in surplus of $2,491,562.

The Park Utah Consolidated Mines Co. operated the Park City unit, consisting of the Daly West and Daly Judge properties, and the Park Utah unit near Keetley in the eastern part of the district in Wasatch County. The output of siliceous silver ore from the Park Utah mine has been steadily decreasing in recent years, and only about 6,000 tons of this material was shipped in 1927. The chief output of the mine is now lead-zinc ore, which is loaded on Union Pacific cars at Keetley and shipped to International and Midvale for milling. It is there separated into zinc concentrate, which is shipped to Black Eagle, Mont., for leaching, and lead concentrate and iron concentrate, which are smelted locally. Besides gold and silver the milling ore contains about 6 per cent of lead and 7.5 per cent of zinc, an increase over the average when milling was started. The Judge mill in Empire Canyon, which treats ore from the Daly West and Daly Judge mines, is still operated as a wet concentration plant; the products are lead concentrate of smelting grade and zinc-iron middling that is treated by flotation at International. First-class ore from these mines and the products of the mill are shipped over the new aerial tramway to the loading station at Park City.

According to the annual report of the Park Utah Consolidated Mines Co. for 1927 the combined output of all mines, including the Ontario and Daly properties which comprise separate corporations, amounted to 394,303 tons of ore; ore and concentrates shipped contained 38,761 ounces of gold, 4,997,078 ounces of silver, 2,540,697 pounds of copper, 50,054,168 pounds of lead, and 49,569,591 pounds of zinc. Much of the zinc contained in the lead ore and concentrate shipped to lead smelters and in ore shipped for milling was lost. The bulk of the ore was milled, and the zinc recovered from the zinc concentrate was probably about 35,000,000 pounds. The total metal contents of the ore and concentrates shipped are shown in the table that follows:

Gold, silver, copper, lead, and zinc contained in ore and concentrates shipped from the properties under control of Park Utah Consolidated Mines Co., Utah, in 1927

Mine	Ore and concentrates	Gold	Silver	Copper	Lead	Zinc	Value received per ton
	Short tons	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*	
Park Utah Consolidated	294, 912	38, 134	4, 289, 823	2, 324, 123	49, 125, 973	47, 971, 686	$14. 13
Ontario	23, 964	611	700, 665	214, 088	909, 885	1, 597, 905	13. 16
Daly	72	16	6, 590	2, 486	18, 310		46. 33
	318, 948	38, 761	4, 997, 078	2, 540, 697	50, 054, 168	49, 569, 591	14. 08

The Park Utah Consolidated Mines Co., exclusive of the Ontario and Daly properties, was the largest producer of silver, lead, and zinc in Utah in 1927 and was second in the production of gold. Dividends paid to stockholders in 1927 amounted to $1,569,125. The dividends paid to date, including those paid by the Judge Mining & Smelting Co., the Park City Mining & Smelting Co., and the Park Utah Consolidated Mines Co., total $17,481,961. The Ontario Silver Mining Co. has paid $14,157,500 and the Daly Mining Co. $3,172,500, making $34,811,961 paid by the companies now under the control of the Park Utah Consolidated Mines Co. The following paragraphs are taken from the company's annual report:

> At the Park Utah unit the major portion of development work has been confined to locating the limits and to determining the size of the large western ore body. Above the 1,800 level this work has brought most satisfactory response, and in the near future this ore will be followed on its downward extension. Recent work on the lowest, or 1,800 level, gives assurance of a large production below this horizon, and plans have been completed for the driving of lower working levels and for a system of pumping operations which will be adequate to efficiently handle the increased flow of water to be expected in draining this area. Exploratory drives to the westward have added important data for the determination of and the location and direction of mineralization toward the Ontario mine. This new information has enhanced the potential value of this block of undeveloped ground.
>
> The Park City unit of the property has continued its record of heavy and profitable production. The geologic conditions present in its large undeveloped territory assure the presence of extensive ore deposits.
>
> No effort has been spared to bring the surface and underground equipment to the highest state of efficiency and to take advantage of any change or improvement to lower the costs of operation. The entire property has now been linked together with its own 44,000-volt transmission lines which operate from a single point of delivery served by two main lines of the power company. This will result in lower power costs and be an additional safeguard against interruption of power service. The entire haulage system of the Park Utah unit has now been changed and a rotary dump constructed for the rapid loading of ores into railroad cars. Important savings in operating costs have resulted, and the transportation capacity of the property is now adequate for any desired increase in the rate of future production.
>
> A satisfactory feature of the year's work is that the operating cost per ton of ore mined has been reduced 20 per cent, and the total expenditures for operations are lower for 1927 than for 1926, although the production of metal and the tonnage of ore mined has increased. Efficient hoisting, pumping, and transportation equipment, and the blocking out of ore bodies for low-cost mining, have been important factors in bringing about this result. * * *
>
> The sharp decline in the average metal prices of 1927 from those of 1926 has in a large measure offset the gain made by increased production and lower operating costs. The effect of the metal market on earnings was made more pronounced by the policy of curtailment of production in the summer months when metals were depressed. During this depression of metal prices production was held to a figure which would only meet dividend requirements of the year. The property is now in a physical condition favorable for the speeding up of ore extraction to take advantage of any rise in the metal market.

The Park Utah Consolidated Mines Co. received $4,295,784 in 1927 from the sale of ore and from other income, paid out $2,726,448 for various expenses (including taxes and depreciation), and had a net income for the year of $1,569,336.

The Daly Mining Co., a separate incorporation controlled and operated by the Park Utah Consolidated Mines Co., shipped only 72 tons of oxidized lead ore containing silver. About 2,000 feet of work, chiefly in drifts and crosscuts, was done at the Daly and Daly West properties.

The Ontario Silver Mining Co., also controlled and worked by the Park Utah Consolidated Mines Co., shipped 23,964 tons of lead-zinc milling ore to the new flotation plant at Midvale. The ore, which carries comparatively little lead and zinc, is highly siliceous and contains considerable silver. The mine was tenth in the production of silver and seventh in the production of zinc in Utah in 1927. Operation was continuous, and about 7,000 feet of development was done.

No ore was shipped from the Keystone mine, but several hundred feet of drifting and about 85 feet of shaft work were done at the adjoining Silver King Consolidated property controlled by the Silver King Coalition Mines Co.

The Glencoe mine, south of Keetley, was worked by the Park Galena Mining Co., which shipped several hundred tons of sulphide lead ore for smelting and considerable lead-zinc ore for custom milling. Most of the year was devoted to building a 100-ton flotation-concentration mill; this mill was not operated until early in 1928. The company also did nearly 800 feet of drifting and sinking, and most of the ore marketed was that taken out in the course of development. The mine, which is near the Park Utah property, is opened by a 400-foot vertical shaft and by drifts and tunnels aggregating 3,650 feet.

The New Quincy Mining Co., owning claims south of the Silver King Coalition ground, shipped several cars of siliceous silver ore and two lots of lead-zinc milling ore for testing. The company was chiefly engaged in development, and 3,000 feet of work was done during 1927. As a result of this exploration a large body of silver-lead ore was opened early in 1928.

Concentrates from creek tailings obtained below the Silver King Coalition mine in Woodside Gulch and also below the Daly Judge mill in Empire Canyon were shipped from the two flotation plants operated by Charles Moore. Shipments of old tailings aggregating several thousand tons were also consigned to the Midvale plant to be treated by flotation.

Development continued at the Three Kings property, and one lot of low-grade oxidized lead ore was marketed. Properties near Keetley which were undergoing development were the Park Standard, Sphinx, and Konold prospects. The Star of Utah Mining Co. continued to develop its property near the Park Utah mine and did nearly 2,000 feet of work.

TOOELE COUNTY

In Tooele County 23 mines produced 68,790 tons of ore and old tailings in 1927, an increase of 28,253 tons over the output from 41 mines in 1926. The recovered gold increased from $51,242 to $80,764, the silver from 204,749 to 287,613 fine ounces, the copper from 179,780 to 229,816 pounds, the lead from 11,071,103 to 15,207,230 pounds, and the zinc from 2,368,563 to 4,045,448 pounds; the total value of the metals increased from $1,267,504 to $1,490,912. The improvement was due to increased shipments of lead ore and lead-zinc ore from the Bullion Coalition (Honerine) property near Stockton, operated by the Combined Metals Reduction Co., and lead ore from the property operated by the Bluestone Lime & Quartzite Mining Co.

At International, west of Bingham, the International Smelting Co., a subsidiary of the Anaconda Copper Mining Co., operated its 1,000-ton flotation plant and its copper and lead smelting plants on custom ore. The copper plant is equipped with roasters, a Cottrell plant, 5 reverberatory furnaces, and 5 converters. The lead plant has 10 Dwight-Lloyd sintering machines and 5 blast furnaces.

The custom flotation plant at International treated 395,683 tons of ore, making lead concentrate and iron concentrate for treatment locally and zinc concentrate for shipment to Great Falls, Mont.

The copper plant treated 116,909 tons of copper material and the lead plant 288,300 tons of ore and concentrates, from which there were produced 146,073,315 pounds of lead, 20,119,391 pounds of copper, 8,001,707 ounces of silver, and 56,849.89 ounces of gold.

From 1917 to 1927 the smelting plants treated 1,341,117 tons of copper material and 2,378,154 tons of lead material, from which 319,909 ounces of gold, 61,418,961 ounces of silver, 194,394,996 pounds of copper, and 817,917,891 pounds of lead were recovered, largely from Utah ores. The totals, by years, from 1916 to 1925 are given in the Mines Handbook.[18] The flotation plant at International was fully described in 1926 by Page [19] and has since been reviewed by McKenna.[20]

Clifton district (*Gold Hill*).—Four lode mines in the Clifton district produced 526 tons of ore, yielding $19,143 in gold, 4,413 ounces of silver, 2,396 pounds of copper, 53,701 pounds of lead, and 14,754 pounds of zinc, valued in all at $26,286, or $49.97 in metals a ton. Nearly all the output was a first-class smelting product, consisting chiefly of lead ore but including some unusually rich gold ore. The Rube group near Gold Hill produced several cars of ore that averaged approximately 6 ounces of gold to the ton. Beautiful specimens of native gold from this property are on exhibit in the basement of the State Capitol at Salt Lake City. The mine was worked seven months, and a new vein was said to have been opened about 1,200 feet north of the gold shaft. A new inclined shaft was sunk 55 feet, and 170 feet of drifting and 60 feet of raising were done in the old inclined shaft, which is 150 feet deep. The Western Utah mine has been closed since January, 1926, but a few cars of low-grade silver ore and lead ore were marketed by lessees. Several cars of oxidized lead ore were shipped from the Gold Hill mine owned by the United States Smelting, Refining & Mining Co. One lot of ore containing lead and zinc was also shipped as a mill test. Three cars of lead-zinc ore of milling grade and one lot of first-class lead ore were shipped from the Success property, 5 miles southeast of Gold Hill. The Garrison Monster mine was being developed by lessees, who did 300 feet of tunnel work.

Columbia district.—The output of the Columbia district consisted of one car of oxidized lead ore from the Sharp mine and three cars of first-class lead ore from the New Erie property, 6 miles south of Vernon. At the Hill Top mine more than $18,000 was spent in development and in building a tramway. An important strike of silver-lead ore was made in July and was followed 100 feet in an inclined shaft. Early in 1928 a concentration plant was erected and a silver-lead product marketed.

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[18] Neale, W. G., The Mines Handbook, vol. 17, p. 94.

[19] Page, W. C., Treatment of Lead-Zinc Ores at International, Utah: Salt Lake Min. Rev., vol. 28, May 15, 1926, p. 14.

[20] McKenna, W. J., Flotation of Custom Lead-Zinc-Iron Ores as Practiced by the International Smelting Co.'s Tooele Plant: Trans. Am. Inst. Min. and Met. Eng., August, 1927.

Erickson district.—Lessees shipped one car of lead ore of smelting grade and one car of lead-zinc milling ore from the Glenn Springs property, for which Lucerne, on the Los Angeles & Salt Lake Railroad, is the shipping point. The property of the Imperial Lead Mining Co., practically idle, produced one car of carbonate lead ore.

Granite Mountain district.—The property of the National Copper Mining Co. was not worked, but one small car of sulphide lead ore was shipped early in the year.

Lakeside district.—Considerable development was done at the Monarch mine, which is opened by a tunnel 1,000 feet long and a vertical shaft 95 feet deep. A large deposit of sulphide lead ore containing only a small amount of silver was said to have been opened in February; several cars of this material were shipped from Delle on the Western Pacific Railroad. At the Lead Prince property, near the Monarch mine, 400 feet of tunnel and shaft work was done.

North Tintic district.—The New Bullion property was worked by lessees, and two cars of lead ore were shipped from Boulter west of Eureka on the Union Pacific Railroad. The Scranton mine, formerly a large producer of zinc, also produced one car of oxidized lead ore.

Ophir district.—Four lode mines in the Ophir district produced 1,271 tons of ore, which yielded $555 in gold, 10,791 ounces of silver, 24,440 pounds of copper, 314,019 pounds of lead, and 392,023 pounds of zinc, valued in all at $54,749, or $43.08 in metals a ton; of this output, 250 tons was first-class smelting ore and 1,021 tons was milling ore reduced to 737 tons of concentrates. Shipments from the Ophir Hill property, a large producer since 1890, ceased in 1925, and the output of the Ophir district has since been comparatively small. Much development, however, has been done at the Ophir Hill, where the sinking of a 3-compartment shaft was continued to explore property to the south near Lion Hill, and also at the Kearsarge, Ophir Mines, Lakes of Killarney, and Buffalo mines. Most of the output of the district in 1927 was from the Hidden Treasure mine, which produced more than 1,000 tons of lead-zinc ore that was milled at a custom concentrator; several cars of first-class lead ore were also marketed. The mine is opened by several tunnels, and about 900 feet of development was done in 1927, but as the shipments consisted of rather low-grade material operations were conducted at a loss. The Eureka-Ophir property produced one car of copper-lead ore containing silver, and the Dry Canyon and Buffalo properties produced three cars of first-class silver-lead ore. A strike of rich sulphide ore containing lead and copper was reported at the Buffalo mine, which was taken over by the Tintic Ophir Mining Co.

Rush Valley district (*Stockton*).—Five lode mines in the Rush Valley district produced 66,573 tons of ore, which yielded $60,963 in gold, 271,325 ounces of silver, 201,781 pounds of copper, 14,692,776 pounds of lead, and 3,634,134 pounds of zinc, valued in all at $1,399,467, or $21.02 in metals a ton. The output consisted of 31,725 tons of first-class silver-lead ore and of 15,307 tons of milling ore and 19,541 tons of old tailings that were reduced to 7,647 tons of concentrates. The Honerine mine at Bauer was operated by the Combined Metals

Reduction Co.; more than 16,000 tons of first-class silver-lead ore was shipped to International for smelting and 34,000 tons of milling ore and old tailings were treated locally at the Bauer flotation plant. This mine, which is an old producer, is extensively developed; 11,768 feet of work was done in drifts, raises, and winzes in 1927. The 150-ton flotation plant of the Combined Metals Reduction Co. was operated the entire year on ore from Utah, Nevada, Idaho, and Colorado. The section of the plant designed to reduce lead concentrate to metallic lead remained idle. Lead concentrate and lead-iron concentrate from the flotation plant were shipped either to International or Murray, and the zinc product went to Great Falls, Mont.

A marked increase was made in the production of metals from the Tip Top and Cyclone claims, about 2 miles from Stockton, worked by the Bluestone Lime & Quartzite Co. More than 14,000 tons of ore containing gold, silver, and lead was shipped to a smelter, and several hundred tons of lead-zinc ore was milled. The property has an 800-foot vertical shaft and is also worked through the Honerine tunnel. About 400 feet of development was done in 1927 in the King drift from the Honerine tunnel. The property was one of the largest producers of lead in Utah in 1927. Several hundred tons of mixed silver-lead ore was shipped by lessees from the Galena King property, owned by the Keystone Development Co. The property was said to have been sold to the Bullion Coalition Mines Co. late in 1927. Several cars of oxidized lead ore were shipped from the Southport mine, and one small lot of oxidized lead ore was also shipped from the Salvation-Hercules property.

Silver Islet district.—One test lot of siliceous silver ore was shipped from the Utah Silver Lake property.

UTAH COUNTY

American Fork district.—The output of the American Fork district was chiefly that of the Live Yankee mine, operated by the Yankee Mines Co. The ore consists mainly of pyrite and chalcopyrite and is valuable chiefly for its gold, which averages about 1 ounce to the ton. The ore is hauled 19 miles down American Fork Canyon to American Fork. Sample lots of lead ore were shipped from the Mary Ellen and Milkmaid properties.

Mine production of gold, silver, copper, lead, and zinc in American Fork district, Utah, 1926–27, and total, 1870–1927

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1926	7	[1]3,466	$28,518	17,455	69,794	337,619	73,204	$81,681
1927	5	1,190	32,209	9,207	87,369	20,706	....	50,179
Total, 1870–1927	....	88,902	453,181	2,010,797	834,645	31,370,728	313,926	4,495,547

[1] Includes 3 tons of slag.

Santaquin district.—The Union Chief property was worked throughout 1927 by lessees, who did about 867 feet of work in drifts and crosscuts.

Tintic district.—The following mines, which are in Utah County, in the eastern part of the Tintic district, are mentioned in the general review under Juab County: Tintic Standard, North Lily, Eureka Lilly, Mountain View, Iron King, Colorado Consolidated, and Yankee Consolidated.

WASHINGTON COUNTY

The mines of the Bull Valley (Gold Strike), Harrisburg, and Tutsagubet districts were not worked. Plans were made for operating the old Silver Reef property at Leeds, Harrisburg district, and a definite campaign of development was started in 1928 to prospect thoroughly and to test the silver-bearing sandstone.

COPPER

By C. E. JULIHN and HELENA M. MEYER[1]

INTRODUCTION

It is less true than formerly that the production of copper requires three operations—mining, smelting, and refining. All copper must be mined; but for years some Lake Superior copper has been smelted and sold as Lake copper without subsequent refining, and a steadily increasing amount of copper is being extracted from ores by leaching methods, which render smelting unnecessary. Nevertheless, it is still practicable to determine the copper production of the United States by three distinct sets of statistics which may be obtained, respectively, from the mines, the smelters, and the refineries.

These separate determinations of production are desirable because each of them has for certain purposes a particular advantage over the others. As they show different aspects of production, the three sets of figures will never agree exactly, but, taken together, they afford complete data on the output of copper.

Details of the geographic distribution of output are shown more precisely by statistics of mine production than by those of smelter and refinery production. Likewise, the character of the ores produced, their contents of copper and other valuable metals, and the treatment, other than smelting, they may have undergone can be learned accurately only from the mines themselves. On the other hand, mine statistics show only the estimated recoverable metal content of the ores.

The actual percentage of crude copper recovered from copper ores, and from other ores having a low content of copper, is shown by the smelter statistics. Lead and zinc ores, siliceous ores of the precious metals, and pyrite roasted in the manufacture of sulphuric acid often carry so little copper that the mines are not paid for it and do not report it, though these sources as a whole yield a considerable amount of copper. Another cause of difference between the figures of mine and of smelter production is the lag in time between the production and the smelting of an ore. For example, most of the ore mined in December of any year is not represented in the figures of smelter production for that year but enters into the figures of the year following. A third cause of difference between these two sets of figures is that the amount of metal contained in ore, matte, and other material held in stock at smelters is rarely the same at the beginning and the end of a year. Smelter statistics, as well as mine statistics, show broadly the geographic distribution of output.

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[1] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The precise amount of copper made available for consumption in a given period, as well as that of the precious metals recovered from crude copper, is shown only by refinery statistics; but these afford little information on the distribution of output according to source and are uncertain even in their classification of the material refined as foreign or domestic.

Differences between smelter and refinery statistics are similar in origin to those existing between mine and smelter statistics, for some time after the copper is smelted must elapse before it is refined, and the quantity of copper in stocks of untreated or unfinished material at the beginning of the year differs from that at the end, not only at smelters but at the refineries as well.

Two or three months usually elapse between the day ore is mined and the day the copper derived from it becomes available for commercial use. Hence, the refinery statistics for the calendar year 1927 represent approximately the ore mined between October, 1926, and October, 1927. In periods when the course of production is little disturbed by pronounced fluctuations of activity the three sets of statistics should not differ greatly; but any decided fall or rise in production between October of one year and March of the year following tends to accentuate the differences among the three sets of figures.

In these reports the smelter output, including that of furnace-refined Lake copper as well as blister copper, has been adopted as the production of the country because smelter figures permit reasonably accurate determination of the distribution of copper production by States and give also the actual output of copper.

In order to have these figures maintain their value for showing the output of the country, it is necessary to include in them some copper produced directly through the leaching of ores and subsequent precipitation by electrolysis, although this fraction of the production is not actually smelted, as is the cement copper precipitated from solutions by means of scrap iron. Since this electrolytically precipitated copper is very pure, refineries merely resmelt it in order to cast it in commercial forms.

SUMMARY OF DOMESTIC AND WORLD STATISTICS

Summary of statistics of the copper industry in the United States, 1918–1927

	1918	1919	1920	1921	1922
Production of copper:					
Smelter output from domestic ores ....pounds..	1, 908, 533, 595	1, 286, 419, 329	1, 209, 061, 040	505, 586, 098	950, 285, 947
Mine production..........do....	1, 910, 022, 841	1, 212, 334, 041	1, 224, 550, 151	466, 190, 853	964, 583, 894
Refinery production of new copper—					
Electrolytic..........pounds..	1, 560, 327, 422	1, 233, 994, 324	1, 010, 240, 867	506, 532, 984	766, 944, 836
Lake..........do....	231, 096, 158	177, 594, 135	153, 483, 952	100, 918, 001	122, 545, 126
Casting and pig..........do....	91, 450, 611	21, 897, 336	18, 698, 421	1, 963, 271	15, 180, 723
Total domestic..........do....	1, 882, 874, 191	1, 433, 485, 795	1, 182, 423, 240	609, 414, 256	904, 670, 685
Total domestic and foreign..do....	2, 394, 297, 521	1, 770, 168, 041	1, 526, 165, 346	950, 777, 815	1, 255, 515, 959
Total new and old copper....do....	3, 100, 000, 000	2, 345, 000, 000	2, 151, 000, 000	1, 385, 000, 000	1, 927, 000, 000
Ore produced:					
Copper ore..........short tons..	62, 289, 069	36, 121, 622	36, 765, 370	13, 396, 382	26, 893, 247
Average yield of copper..per cent..	1. 51	1. 65	1. 63	1. 70	1. 74
Copper-lead and copper-lead-zinc ores..........short tons..	15, 698	17, 632	26, 890	14, 248	52, 370
Average price per pound......cents..	24. 7	18. 6	18. 4	12. 9	13. 5
Imports (unmanufactured)..pounds..	575, 805, 115	429, 387, 594	485, 670, 691	350, 472, 611	541, 013, 220

Summary of statistics of the copper industry in the United States, 1918–1927—Con.

	1918	1919	1920	1921	1922
Exports of metallic copper [1]..pounds..	744, 243, 481	515, 595, 019	623, 158, 489	628, 415, 714	742, 755, 957
Withdrawn from total supply on domestic account:					
Total new copper..........pounds .	1, 661, 669, 576	914, 471, 572	1, 053, 838, 558	610, 988, 744	896, 633, 833
Total new and old copper....do....	2, 367, 000, 000	1, 489, 000, 000	1, 679, 000, 000	1, 046, 000, 000	1, 568, 000, 000
Stocks at end of year:					
Refined copper...............do....	180, 000, 000	631, 000, 000	659, 000, 000	459, 000, 000	216, 000, 000
Blister and materials in solution...................pounds..	562, 600, 000	273, 000, 000	465, 000, 000	283, 000, 000	361, 000, 000
World production (smelter)....do....	3, 148, 531, 000	2, 191, 394, 000	2, 114, 349, 000	1, 229, 277, 000	1, 904, 793, 000
Value of smelter production from domestic ores......................	$471, 408, 000	$239, 274, 000	$222, 467, 000	$65, 221, 000	$128, 289, 000

	1923	1924	1925	1926	1927
Production of copper:					
Smelter output from domestic ores ....pounds..	1, 434, 999, 962	1, 634, 249, 192	1, 674, 869, 886	1, 739, 622, 094	1, 684, 040, 983
Mine production..............do....	1, 477, 739, 709	1, 606, 165, 018	1, 678, 117, 747	1, 725, 275, 931	1, 649, 959, 370
Refinery production of new copper—					
Electrolytic...............pounds..	1, 302, 454, 492	1, 499, 223, 447	1, 533, 995, 439	1, 553, 041, 424	1, 520, 076, 181
Lake.......................do....	137, 691, 306	145, 333, 227	138, 029, 764	172, 372, 304	195, 135, 199
Casting....................do....	24, 019, 197	29, 657, 925	10, 870, 144	5, 883, 433	3, 740, 819
Total domestic.............do....	1, 464, 164, 995	1, 674, 214, 599	1, 682, 895, 347	1, 731, 297, 161	1, 718, 952, 199
Total domestic and foreign ....pounds..	1, 979, 835, 616	2, 260, 076, 010	2, 204, 573, 824	2, 322, 485, 376	2, 325, 763, 709
Total new and old copper....do....	2, 802, 000, 000	3, 037, 000, 000	3, 045, 000, 000	3, 282, 000, 000	3, 306, 000, 000
Ore produced:					
Copper ore.............short tons..	45, 519, 317	49, 178, 315	53, 103, 014	57, 181, 894	56, 725, 460
Average yield of copper..per cent..	1. 58	1. 59	1. 54	1. 46	1. 41
Copper-lead and copper-lead-zinc ores.................short tons..	162, 181	219, 874	228, 612	282, 015	418, 601
Average price per pound ......cents..	14. 7	13. 1	14. 2	14. 0	13. 1
Imports (unmanufactured)..pounds..	676, 473, 338	768, 813, 731	652, 971, 407	779, 441, 803	718, 322, 990
Exports of metallic copper [1]....do	828, 854, 827	1, 116, 775, 136	1, 082, 369, 439	960, 220, 112	1, 069, 493, 121
Withdrawn from total supply on domestic account:					
Total new copper..........pounds..	1, 300, 473, 331	1, 354, 742, 564	1, 401, 012, 091	1, 570, 136, 207	1, 422, 959, 219
Total new and old copper....do....	2, 122, 000, 000	2, 131, 000, 000	2, 241, 000, 000	2, 530, 000, 000	2, 403, 000, 000
Stocks at end of year:					
Refined copper...............do....	264, 000, 000	243, 000, 000	124, 000, 000	146, 000, 000	171, 000, 000
Blister and materials in solution ....pounds..	432, 000, 000	393, 000, 000	432, 000, 000	455, 000, 000	401, 000, 000
World production (smelter).....do....	2, 683, 025, 000	2, 985, 058, 000	3, 093, 085, 000	3, 214, 339, 000	3, 333, 388, 000
Value of smelter production from domestic ores......................	$210, 945, 000	$214, 087, 000	$237, 832, 000	$243, 547, 000	$220, 609, 000

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[1] Total exports of copper, exclusive of ore, concentrates, and composition metal, and for 1923–1927 of unrefined copper, figures for which are not separable from those for ore and concentrates. For 1926 and 1927, exclusive also of "Other manufactures of copper," for which figures of quantity are not recorded.

Copper produced in the United States from domestic ores, 1922–1927

[Smelter output, in pounds fine]

State	1922	1923	1924	1925	1926	1927
Alaska............	59, 900, 579	68, 648, 368	77, 053, 492	72, 204, 166	67, 631, 846	56, 489, 214
Arizona..........	428, 200, 634	615, 493, 561	672, 365, 115	722, 653, 457	729, 324, 537	681, 168, 117
California.........	20, 440, 430	27, 042, 835	49, 433, 716	46, 943, 604	30, 442, 961	25, 802, 603
Colorado..........	3, 635, 916	4, 343, 418	4, 158, 612	3, 163, 211	4, 657, 591	8, 006, 801
Georgia...........	8, 147	------------	------------	------------	------------	------------
Idaho.............	3, 504, 944	3, 664, 079	3, 148, 519	3, 144, 064	1, 171, 262	1, 811, 103
Michigan..........	122, 545, 126	137, 691, 306	145, 333, 227	138, 029, 764	174, 778, 884	195, 135, 199
Missouri..........	1, 070, 259	217, 449	184, 947	12, 114	54, 378	5, 041
Montana..........	165, 341, 414	224, 353, 764	249, 322, 394	270, 604, 676	257, 271, 936	225, 208, 853
Nevada...........	20, 398, 611	63, 495, 928	77, 281, 479	77, 137, 563	109, 041, 769	118, 298, 342
New Mexico.......	29, 127, 329	57, 521, 171	78, 145, 629	76, 467, 245	82, 848, 096	79, 761, 222
North Carolina...	------------	61, 913	------------	------------	1, 468, 746	5, 362, 041
Oregon...........	925, 954	1, 182, 437	716, 656	126, 107	279, 223	484, 652
Pennsylvania.....	888, 721	1, 121, 573	1, 263, 535	562, 240	495, 698	2, 149, 182
Tennessee........	14, 226, 232	18, 721, 932	18, 251, 996	19, 789, 234	18, 601, 586	14, 498, 951
Texas............	3, 889	4, 216	302	785	17, 102	25, 460
Utah.............	79, 665, 563	210, 118, 291	256, 531, 349	242, 730, 986	259, 649, 158	267, 705, 597
Vermont..........	------------	------------	------------	------------	446, 323	238, 143
Washington.......	369, 133	839, 254	978, 647	1, 184, 807	1, 336, 617	1, 766, 953
Wyoming..........	------------	87, 686	------------	331	------------	------------
Undistributed....	33, 066	390, 781	79, 577	115, 532	104, 381	123, 509
	950, 285, 947	1, 434, 999, 962	1, 634, 249, 192	1, 674, 869, 886	1, 739, 622, 094	1, 684, 040, 983

The accompanying table shows the world smelter production of copper by countries where smelted but not necessarily where refined. So far as possible, material from scrap has been eliminated. As the figures for the United States for 1923 to 1926, inclusive, do not include the smelter product from foreign ores, concentrates, and mattes, the content of the imports of these materials has been included in the total for the world, in so far as can be done without duplication of figures shown elsewhere in the table.

World smelter production of copper, 1923–1927, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country[1]	1923	1924	1925	1926	1927
North America:					
Canada	18,877	24,438	22,180	30,199	18,260
Mexico	39,019	33,359	33,531	36,426	[2]38,000
United States	[3]650,912	[3]741,283	[3]759,708	[3]789,075	[4]843,850
	708,808	799,080	815,419	855,700	900,110
South America:					
Chile	162,464	174,496	176,811	188,875	226,160
Peru	[5]44,166	[5]33,938	[5]36,864	[5]42,940	46,377
	206,630	208,434	213,675	231,815	272,537
Europe:					
Austria	4,833	3,848	3,779	3,203	3,308
Belgium	7,910	8,930	11,140	10,006	9,810
Czechoslovakia	152	301	469	699	743
France	5,628	2,299	3,420	2,150	2,250
Germany[6]	26,200	34,600	39,100	46,200	52,900
Great Britain[7]	23,200	21,500	20,700	17,900	22,600
Italy	184	10	578	420	450
Norway	67	71	251	192	13
Rumania[8]	71	90	133	189	86
Russia[9]	1,758	3,147	9,042	10,835	[2]20,000
Spain	13,186	16,597	21,298	23,925	28,689
Sweden[10]	(11)	2,005	3,727	3,894	5,406
Yugoslavia	6,788	8,101	7,301	9,671	12,863
	89,977	101,499	120,938	129,284	159,118
Asia:					
China[12]	849	842	1,048	2,068	1,052
Chosen	----------	----------	418	766	1,004
India, British	190	----------	----------	----------	----------
Japan	59,346	63,056	66,487	67,365	66,571
	60,385	63,898	67,953	70,199	68,627
Africa:					
Belgian Congo	57,886	85,570	90,104	80,639	89,156
Rhodesia—					
Northern	132	100	75	719	3,343
Southern	2,697	2,565	1,714	7	----------
Union of South Africa	7,979	8,383	7,819	8,820	9,272
	68,694	96,618	99,712	90,185	101,771

[1] In addition to the countries listed, copper is smelted in Asiatic Turkey, but data of output are not available.

[2] Approximate production.

[3] Smelter output from domestic material, exclusive of scrap. The production of refined copper from domestic and foreign material, exclusive of scrap, is reported as follows, in metric tons: 1923, 898,034 tons; 1924, 1,025,148 tons; 1925, 999,973 tons; 1926, 1,053,456 tons; 1927, 1,054,943 tons.

[4] Smelter output from domestic and foreign material, exclusive of scrap. The production from domestic material only, exclusive of scrap, amounted to 763,864 tons; figures for smelter output from foreign ores not available prior to 1927.

[5] Includes copper contained in ores, concentrates, and mattes exported.

[6] Exclusive of material from scrap. (Metallgesellschaft, Stat. Zusammenstell.)

[7] Approximate production. (Min. Res. Dept., Imp. Inst.)

[8] Smelter output from domestic ores.

[9] Year ended Sept. 30.

[10] Exclusive of material from scrap.

[11] Total output from scrap. Production reported as 119 tons.

[12] Exports of ingots and slabs.

World smelter production of copper, 1923–1927, in metric tons—Continued

Country	1923	1924	1925	1926	1927
Oceania:					
Australia	18,111	14,326	11,160	11,327	9,718
Papua [13]			89	173	
	18,111	14,326	11,249	11,500	9,718
	[14] 1,217,000	[14] 1,354,000	[14] 1,403,000	[14] 1,458,000	1,512,000

[13] Copper content of blister exported in year ended June 30 of year stated.

[14] Includes copper content of ores, concentrates, and mattes imported into the United States not elsewhere included.

World mine production of copper, 1923–1927, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country [1]	1923	1924	1925	1926	1927
North America:					
Canada	39,409	47,381	50,553	60,371	63,569
Cuba [2]	10,618	10,614	14,135	9,028	13,433
Mexico	53,372	50,062	54,596	56,347	58,734
Newfoundland	[3] 91	(4)			
United States	670,288	728,540	761,177	782,568	748,405
	773,778	836,597	880,461	908,314	884,141
South America:					
Argentina [5]	300	800	800	800	800
Bolivia [3]	10,049	7,439	7,235	8,130	8,729
Chile	206,023	213,856	243,219	243,558	296,300
Peru	44,166	33,938	36,844	42,511	55,368
Venezuela	2,137	1,778	2,228	2,043	[5] 2,000
	262,675	257,811	290,326	297,042	363,197
Europe:					
Austria	1,684	1,941	1,840	2,238	2,332
Bulgaria [5]	1,000	1,000	1,000	1,700	1,300
Czechoslovakia	(6)	(6)	(6)	600	1,160
Finland	507	368	1,374	991	836
France	30	14	(7)	(7)	(7)
Germany	18,467	22,944	24,446	27,687	27,271
Great Britain	89	123	97	110	180
Hungary	2	4	5	(7)	(7)
Italy	1,100	857	826	1,490	1,690
Norway	8,534	9,510	31,693	6,207	12,367
Portugal [5]	2,000	2,000	2,000	2,000	2,000
Rumania [8]	71	90	133	189	86
Russia [9]	1,984	3,312	5,426	11,636	12,000
Spain	33,409	26,291	48,100	49,500	51,800
Sweden	1,550	1,679	1,960	1,748	2,000
Yugoslavia	6,808	8,143	9,693	12,100	12,900
	77,235	78,276	128,593	118,196	127,922
Asia:					
China [10]	849	842	1,048	2,068	1,052
Cyprus	1,250	2,821	[3] 3,521	[3] 3,056	[3] 4,229
India, British	248	1,254	3,500	6,200	5,100
Japan—					
Japan proper [8]	59,346	63,056	66,487	67,365	66,571
Chosen [11]	(11)	(11)	(11)	(11)	(11)
Taiwan	707	946	689	1,717	1,384
	62,400	68,919	75,245	80,406	78,336

[1] In addition to the countries listed, copper is produced in Asiatic Turkey, but data of output are not available.

[2] Copper content of ore, concentrates, and matte imported into the United States.

[3] Copper content of exports.

[4] Production of 9 tons of copper ore reported, content not stated.

[5] Approximate production.

[6] The following quantities of copper ore reported produced in Czechoslovakia, content not stated: 1923, 172 tons; 1924, 590 tons; 1925, 3,606 tons.

[7] Data not available

[8] Smelter product.

[9] Year ended Sept. 30.

[10] Exports of ingots and slabs.

[11] The following quantities of copper ore are reported produced in Chosen, content not stated: 1923, 65 tons; 1924, 654 tons; 1925, 1,011 tons; 1926, 1,723 tons; 1927, 2,087 tons. In addition, considerable quantities of cupriferous sulphide ores are produced.

World mine production of copper, 1923–1927, in metric tons—Continued

Country	1923	1924	1925	1926	1927
Africa:					
Algeria	458	560	468	489	273
Belgian Congo[8]	57,886	85,570	90,104	80,639	89,156
French Congo	113	291	(7)	(7)	1,121
Madagascar	(12)	--------	(12)	--------	--------
Morocco, French	--------	10	9	[3] 45	(7)
Rhodesia—					
Northern[8]	132	100	75	719	3,343
Southern[8]	2,697	2,565	1,714	7	--------
Southwest African Protectorate	9,044	8,021	8,334	8,984	10,268
Tunisia	47	15	--------	--------	12
Union of South Africa[8]	7,979	8,383	7,819	8,820	9,272
	78,356	105,515	109,000	99,703	113,445
Oceania:					
Australia	17,997	14,807	12,007	8,862	10,133
New Caledonia	(13)	--------	--------	--------	--------
Papua[14]	(15)	2	528	1,686	117
	17,997	14,809	12,535	10,548	10,250
	1,273,000	1,362,000	1,496,000	1,514,000	1,577,000

[3] Copper content of exports.
[7] Data not available.
[8] Smelter product.
[12] Exports of copper ore are reported as follows, content not stated: 1923, 9 tons; 1925, 3 tons.
[13] Production of 82 tons of copper ore reported, content not stated.
[14] Copper content of exports for year ended June 30 of year stated.
[15] Less than one-half ton (240 kilograms).

GENERAL CONDITIONS

In 1927 the world smelter production of new copper, as compiled by the Bureau of Mines from official reports, totaled 1,667,000 short tons, a monthly average of 138,917 tons, or, as more commonly expressed, 277,834,000 pounds per month.

Of the world total North and South America together contributed 1,292,600 short tons, or 77.5 per cent. The United States smelter output from domestic and foreign ores, etc., was 930,190 short tons, or 55.8 per cent of the world total; Mexico furnished nearly 42,000 short tons, or 2.5 per cent; Canada, 20,128 short tons, or 1.2 per cent; and Chile and Peru together about 300,000 short tons, or 18 per cent. Europe produced 175,397 short tons, or 10.5 per cent of the world total; Africa produced 112,183 short tons, or 6.7 per cent; Japan produced 73,382 short tons, or 4.4 per cent; and Australia produced 10,712 short tons, or 0.6 per cent.

The production of the world in 1927 represented an increase of about 4 per cent over that in 1926, or about the same as the average annual increase during the past few years.

The world's visible stocks decreased nearly 50,000 tons in 1927. Stocks of blister and refined copper in the United States decreased only a little less than 15,000 tons, but stocks abroad decreased more than 34,000 tons.

Interpretation of the course of events is rendered difficult by deep-seated and more or less obscure psychological factors that resulted as an aftermath of the war. The copper industry had really accomplished a herculean task in avoiding a major disaster while enormous invisible as well as visible stocks of copper were absorbed; but many anticipated a huge overproduction and continuing low prices for the metal as a result of new production, especially from Africa. They took little account of the long-time record of copper production which indicates the remarkable persistence in expansion of consumption (discussed in the report of this series in Mineral Resources, 1926). Those who believed that copper stocks were excessive may not have recognized the fact that a large part, perhaps more than half, of the total stocks was continuously fixed in process of production.

The first half of the year 1927 was a period of curtailed production in the United States, hand-to-mouth buying, and declining prices, the lowest average monthly price of the year being 12.37 cents a pound for June. Thereafter it was realized that a great reduction of invisible supplies and of European stocks had been in progress and that the reduction of deliveries of copper in the United States had been much more than balanced by increased European deliveries. An important factor in the latter was the large purchases made by Germany which more than offset the decrease in purchases by France. Buying was therefore resumed, and the price of copper rose to an average of 13.77 cents for December.

The average price per pound of copper (all grades) was 13.1 cents for 1927, as compared with 14 cents for 1926. It has been reported that in recent years manufacturers in the United States have generally reduced their copper stocks, throwing a heavier burden upon producers to supply requirements as they arise; as the change in basis has been accomplished, no further effect upon prices should be expected from this cause.

A somewhat parallel situation exists with respect to a greatly increased saving of scrap copper now practiced in the United States. Although this has probably had an important effect in the past few years, the effect is not likely to be intensified in proportion to the normal increase of consumption.

In Chile in 1927 the Andes Copper Co. began to produce, with an annual rate of more than 50,000,000 pounds; the Chile Exploration Co. completed new plant units that increased its capacity for production; and the Braden Copper Co. increased its output by about 12 per cent.

At the end of the year Union Minière du Haut-Katanga (Belgian Congo) made a new production record—22,000,000 pounds in a month. This was made possible by completion of new furnace units and of the railroad line to the west coast permitting the use in production of a limited labor supply that had been required in construction work. At the Greene Cananea property (Mexico) a large and rich extension of the nearly depleted ore body was made. The Rouyn district in Canada began production.

Copper Exporters, incorporated in 1926, has made substantial progress in improving conditions of trade in copper abroad. The Copper Institute was organized in November, 1927, by American producers and smelting companies for the purpose of compiling information in regard to production and marketing of copper for the guidance of the copper industry. It will merely place information before members and others interested without formulating policies or advising its members as to any course of action.

PRODUCTION

SMELTER PRODUCTION

The copper output of the United States smelters in 1927 from domestic ores was 55,581,111 pounds less than the peace-time record output of 1926.

The domestic smelter output from ores of domestic origin represented 56 per cent of the world's copper production in 1913, 61 per cent in 1918, 57 per cent in 1920, 41 per cent in 1921, 50 per cent in 1922, 53 per cent in 1923, 55 per cent in 1924, 54 per cent in 1925 and 1926, and 52 per cent in 1927.

Copper produced (smelter output) in the United States, 1845–1927

[Values rounded]

Year	Quantity	Increase	Value	Year	Quantity	Increase	Value
	Pounds	*Pounds*			*Pounds*	*Pounds*	
1845	224,000	------------	$45,000	1888	226,361,466	45,440,942	$38,029,000
1846	336,000	112,000	57,000	1889	226,775,962	414,496	30,615,000
1847	672,000	336,000	124,000	1890	259,763,092	32,987,130	40,523,000
1848	1,120,000	448,000	218,000	1891	284,121,764	24,358,672	36,368,000
1849	1,568,000	448,000	349,000	1892	344,998,679	60,876,915	40,020,000
1850	1,456,000	[1]112,000	320,000	1893	329,354,398	[1]15,644,281	35,570,000
1851	2,016,000	560,000	334,000	1894	354,188,374	24,833,976	33,648,000
1852	2,464,000	448,000	542,000	1895	380,613,404	26,425,030	40,726,000
1853	4,480,000	2,016,000	985,000	1896	460,061,430	79,448,026	49,687,000
1854	5,040,000	560,000	1,108,000	1897	494,078,274	34,016,844	59,289,000
1855	6,720,000	1,680,000	1,814,000	1898	526,512,987	32,434,713	65,288,000
1856	8,960,000	2,240,000	2,419,000	1899	568,666,921	42,153,934	97,242,000
1857	10,752,000	1,792,000	2,688,000	1900	606,117,166	37,450,245	100,615,000
1858	12,320,000	1,568,000	2,833,000	1901	602,072,519	[1]4,044,647	100,546,000
1859	14,112,000	1,792,000	3,104,000	1902	659,508,644	57,436,125	80,460,000
1860	16,128,000	2,016,000	3,709,000	1903	698,044,517	38,535,873	95,632,000
1861	16,800,000	672,000	3,696,000	1904	812,537,267	114,492,750	104,005,000
1862	21,160,000	4,360,000	4,655,000	1905	888,784,267	76,247,000	138,650,000
1863	19,040,000	[1]2,120,000	6,473,000	1906	917,805,682	29,021,415	177,136,000
1864	17,920,000	[1]1,120,000	8,422,000	1907	868,996,491	[1]48,809,191	173,799,000
1865	19,040,000	1,120,000	7,473,000	1908	942,570,721	73,574,230	124,419,000
1866	19,936,000	896,000	6,828,000	1909	1,092,951,624	150,380,903	142,084,000
1867	22,400,000	2,464,000	5,682,000	1910	1,080,159,509	[1]12,792,115	137,180,000
1868	25,984,000	3,584,000	5,976,000	1911	1,097,232,749	17,073,240	137,154,000
1869	28,000,000	2,016,000	6,790,000	1912	1,243,268,720	146,035,971	205,139,000
1870	28,224,000	224,000	5,977,000	1913	1,224,484,098	[1]18,784,622	189,795,000
1871	29,120,000	896,000	7,023,000	1914	1,150,137,192	[1]74,346,906	152,968,000
1872	28,000,000	[1]1,120,000	9,956,000	1915	1,388,009,527	237,872,335	242,902,000
1873	34,720,000	6,720,000	9,721,000	1916	1,927,850,548	539,841,021	474,288,000
1874	39,200,000	4,480,000	8,624,000	1917	1,886,120,721	[1]41,729,827	514,911,000
1875	40,320,000	1,120,000	9,152,000	1918	1,908,533,595	22,412,874	471,408,000
1876	42,560,000	2,240,000	8,937,000	1919	1,286,419,329	[1]622,114,266	239,274,000
1877	47,040,000	4,480,000	8,937,000	1920	1,209,061,040	[1]77,358,289	222,467,000
1878	48,160,000	1,120,000	7,994,000	1921	505,586,098	[1]703,474,942	65,221,000
1879	51,520,000	3,360,000	9,582,000	1922	950,285,947	444,699,849	128,289,000
1880	60,480,000	8,960,000	12,943,000	1923	1,434,999,962	484,714,015	210,945,000
1881	71,680,000	11,200,000	13,046,000	1924	1,634,249,192	199,249,230	214,087,000
1882	90,646,232	18,966,232	17,313,000	1925	1,674,869,886	40,620,694	237,832,000
1883	115,526,053	24,879,821	19,062,000	1926	1,739,622,094	64,752,208	243,547,000
1884	144,946,653	29,420,600	18,843,000	1927	1,684,040,983	[1]55,581,111	220,609,000
1885	165,875,483	20,928,830	17,915,000				
1886	157,763,043	[1]8,112,440	17,512,000		39,225,723,634	------------	6,416,592,000
1887	181,477,331	23,714,288	25,044,000				

[1] Decrease.

The figures of smelter production in 1927 are based on confidential returns from all known smelting companies handling copper-bearing materials from the United States. Sincere thanks are extended to all companies and officials who have aided in furnishing this information and have given valuable time to answering inquiries concerning distribution of the output. The following list gives the names of the owning or operating companies, the location, and the final copper product of smelting and refining plants treating material from the United States during 1927. It does not include lead and zinc plants that recovered copper as a by-product from mixed ores. Lists of lead and zinc smelters can be found in the chapters on those metals.

Copper reduction plants that treated materials from the United States in 1927

Location	Company	Final copper product
Arizona:		
Ajo	New Cornelia Copper Co	Electrolytic.
Clarkdale	United Verde Copper Co	Blister.
Do	United Verde Extension Mining Co	Do.
Clifton	Phelps Dodge Corporation	Do.
Douglas	Calumet & Arizona Mining Co	Do.
Do	Phelps Dodge Corporation	Do.
Hayden	American Smelting & Refining Co	Do.
Inspiration	Inspiration Cons. Copper Co	Electrolytic.
Miami	International Smelting Co	Blister.
Superior	Magma Copper Co	Do.
California: Copperopolis	Calaveras Copper Co	Do.
Maryland: Baltimore	Baltimore Copper Smelting & Rolling Co	Electrolytic.
Michigan:		
Hancock	Quincy Mining Co	Anodes and Lake.
Houghton	Michigan Smelting Co	Do.
Hubbell	Calumet & Hecla Cons. Copper Co	Do.
Montana:		
Anaconda	Anaconda Copper Mining Co	Blister.
Great Falls	do	Electrolytic.
Nevada:		
McGill	Nevada Consolidated Copper Co	Blister.
Thompson	Mason Valley Mines Co	Do.
New Jersey:		
Chrome	United States Metals Refining Co	Blister and electrolytic.
Maurer	American Smelting & Refining Co	Do.
Perth Amboy	Raritan Copper Works	Electrolytic.
New York: Laurel Hill	Nichols Copper Co	Blister and electrolytic.
Tennessee:		
Copperhill	Tennessee Copper Co	Blister.
Isabella	Ducktown Chemical & Iron Co	Do.
Texas: El Paso	American Smelting & Refining Co	Do.
Utah:		
Garfield	do	Do.
International	International Smelting Co	Do.
Washington: Tacoma	American Smelting & Refining Co	Blister and electrolytic.

During the year the copper smelting and refining plants shown above treated material from the United States; all of these were domestic plants. The figures of production represent the actual smelter recovery. For Michigan it is the sum of furnace-refined copper and copper cast into anodes for electrolytic refining. As to blister copper, the figures represent the fine copper content. Some casting and electrolytic copper is produced direct from ore or matte, and this is included in the smelter production. Metallic and cement copper recovered by leaching is also included in smelter production.

MINE PRODUCTION

The figures of mine production are based on reports furnished to the Bureau of Mines by all mines producing copper. The mines and smelters of several of the large copper producers are under the same management, and their production is reported on the same basis. The figures furnished by mines that ship to custom smelters or have only matting furnaces and ship their matte for conversion are likely to differ considerably from the smelter returns, as the mines may report a considerable quantity that has not reached the stage of blister copper by the end of the year and is consequently not included in the smelter production, or material that was reported by the mines in one year may be treated by the smelters in the following year.

This discrepancy is more pronounced if a marked change in rate of production occurs at the beginning or the end of the year, so that there is not the balance of overlap that occurs if the industry is in normal condition throughout the year. Considerable copper is recovered by the smelters from ores that are treated primarily for other metals, the copper content being so low that it is not paid for and consequently is not always reported by the mines. The difference between the smelter and the refinery production is accounted for by change in the stocks of blister copper and bluestone and the loss in refining.

Copper produced from domestic ores as reported by mines, smelters, and refineries, 1918–1927, in pounds

Year	Mine	Smelter	Refinery
1918	1, 910, 022, 841	1, 908, 533, 595	1, 882, 874, 191
1919	1, 212, 334, 041	1, 286, 419, 329	1, 433, 485, 795
1920	1, 224, 550, 151	1, 209, 061, 040	1, 182, 423, 240
1921	466, 190, 853	505, 586, 098	609, 414, 256
1922	964, 583, 894	950, 285, 947	904, 670, 685
1923	1, 477, 739, 709	1, 434, 999, 962	1, 464, 164, 995
1924	1, 606, 165, 018	1, 634, 249, 192	1, 674, 214, 599
1925	1, 678, 117, 747	1, 674, 869, 886	1, 682, 895, 347
1926	1, 725, 275, 931	1, 739, 622, 094	1, 731, 297, 161
1927	1, 649, 959, 370	1, 684, 040, 983	1, 718, 952, 199

PRODUCTION BY STATES

The mine and smelter production figures, by States, for 1926 and 1927 are shown in the table following; in the second table following the smelter production from 1845 through 1927, by States, is shown. Arizona, Utah, Montana, and Michigan led in production for 1927 with 81 per cent of the smelter output; if the production of Nevada, New Mexico, and Alaska is added to the output of these States, 96 per cent of the output of the country is represented. In total production from 1845 through 1927 Arizona, Montana, and Michigan are especially impressive, having made 31.48, 24.10, and 20.08 per cent, respectively, of the country's total output, and Utah stands fourth with 9.50 per cent; the four States together have produced 85 per cent of the total. If the production of Nevada, New Mexico, Alaska, California, and Tennessee is added to that of the four States mentioned, 98 per cent of the country's total output is represented.

Copper produced in the United States, 1926–27, according to smelter and mine returns, by States, in pounds

State	1926		1927			
				Smelter returns		
	Smelter returns	Mine returns	Rank	Percentage of total	Quantity	Mine returns
Alaska	67, 631, 846	67, 778, 000	7	3. 35	56, 489, 214	55, 343, 000
Arizona	729, 324, 537	723, 296, 051	1	40. 45	681, 168, 117	682, 190, 547
California	30, 442, 961	33, 466, 299	8	1. 53	25, 802, 603	27, 133, 008
Colorado	4, 657, 591	3, 403, 850	10	. 48	8, 006, 801	5, 670, 581
Idaho	1, 171, 262	1, 337, 442	13	. 11	1, 811, 103	2, 173, 163
Michigan	174, 778, 884	175, 381, 565	4	11. 59	195, 135, 199	177, 537, 775

Copper produced in the United States, 1926–27, according to smelter and mine returns, by States, in pounds—Continued

State	1926		1927			
	Smelter returns	Mine returns	Rank	Smelter returns		Mine returns
				Percentage of total	Quantity	
Missouri	54,378	1,077,000	18		5,041	451,000
Montana	257,271,936	255,372,862	3	13.37	225,208,853	223,492,639
Nevada	109,041,769	101,827,937	5	7.02	118,298,342	120,259,276
New Mexico	82,848,096	81,642,379	6	4.74	79,761,222	74,251,863
North Carolina	1,468,746	1,468,700	11	.32	5,362,041	5,443,115
Oregon	279,223	296,454	15	.03	484,652	488,200
Pennsylvania	495,698	1,018,536	12	.13	2,149,182	1,735,800
Tennessee	18,601,586	18,606,664	9	.86	14,498,951	14,940,595
Texas	17,102	12,620	17		25,460	21,458
Utah	259,649,158	257,464,482	2	15.90	267,705,597	256,933,278
Vermont	446,323	473,200	16	.01	238,143	208,224
Washington	1,336,617	1,351,890	14	.10	1,766,953	1,685,848
Undistributed	104,381			.01	123,509	
	1,739,622,094	1,725,275,931		100.00	1,684,040,983	1,649,959,370

Copper produced in the United States, 1845–1927, by States

[Smelter output]

State	Pounds	Percentage	Rank
Alaska	1,077,185,249	2.75	7
Arizona	12,350,131,354	31.48	1
California	996,291,202	2.54	8
Colorado	318,570,735	.81	10
Idaho	130,894,586	.33	11
Michigan	7,874,891,610	20.08	3
Montana	9,453,497,508	24.10	2
Nevada	1,423,162,126	3.63	5
New Mexico	1,120,074,087	2.86	6
Oregon	19,264,923	.05	14
Tennessee	[1]502,643,000	1.28	9
Utah	3,724,963,905	9.50	4
Washington	24,170,481	.06	13
Wyoming	31,673,137	.08	12
Other States and unapportioned	178,309,731	.45	
	39,225,723,634	100.00	

[1] Approximate production.

Mine production of copper in the principal districts, 1926–27

[Districts that produced over 1,000,000 pounds]

District or region	State	1926		1927	
		Mine output (pounds)	Percentage of total production	Mine output (pounds)	Percentage of total production
Bingham	Utah	248,975,000	14.43	249,919,000	15.15
Butte	Montana	252,991,000	14.66	221,312,000	13.41
Lake Superior	Michigan	175,382,000	10.17	177,538,000	10.76
Globe-Miami	Arizona	175,386,000	10.17	171,167,000	10.37
Yavapai County (mostly Jerome district).	do	155,368,000	9.01	141,642,000	8.58
Bisbee (Warren)	do	140,668,000	8.15	138,595,000	8.40
Ely (Robinson)	Nevada	95,009,000	5.51	107.441,000	6.51

Mine production of copper in the principal districts, 1926–27—Continued

District or region	State	1926		1927	
		Mine output (pounds)	Percentage of total production	Mine output (pounds)	Percentage of total production
Ajo	Arizona	82, 350, 000	4. 77	72, 933, 000	4. 42
Central (including Santa Rita)	New Mexico	75, 219, 000	4. 36	66, 971, 000	4. 06
Ray (Mineral Creek)	Arizona	69, 930, 000	4. 05	62, 860, 000	3. 81
Morenci-Metcalf	do	63, 950, 000	3. 71	59, 760, 000	3. 62
Copper River	Alaska	(1)	(1)	(1)	(1)
Pioneer	Arizona	29, 055, 000	1. 68	28, 221, 000	1. 71
Plumas County	California	22, 163, 000	1. 28	21, 055, 000	1. 28
Ducktown	Tennessee	18, 607, 000	1. 08	14, 941, 000	. 91
Prince William Sound	Alaska	(1)	(1)	(1)	(1)
Yerington	Nevada	5, 450, 000	. 32	9, 504, 000	. 58
Swain County	North Carolina	1, 469, 000	. 09	5, 443, 000	. 33
Shasta County	California	5, 061, 000	. 29	4, 525, 000	. 27
Lordsburg	New Mexico	4, 763, 000	. 28	3, 933, 000	. 24
Tintic	Utah	5, 226, 000	. 30	3, 783, 000	. 23
Saguache County	Colorado	(2)		3, 379, 000	. 20
Park City	Utah	2, 279, 000	. 13	2, 595, 000	. 16
Silver Bell	Arizona	1, 828, 000	. 11	2, 442, 000	. 15
Willow Creek	New Mexico			1, 989, 000	. 12
Banner	Arizona	2, 350, 000	. 14	1, 808, 000	. 11
Lebanon (Cornwall mine)	Pennsylvania	1, 019, 000	. 06	1, 736, 000	. 11
Index	Washington	1, 348, 000	. 08	1, 602, 000	. 10
Montana	Montana	1, 639, 000	. 09	1, 575, 000	. 10
San Juan County	Colorado	1, 560, 000	. 09	1, 549, 000	. 09
Jack Rabbit	Nevada	(2)		1, 392, 000	. 08
Battle Mountain	do	(2)		1, 313, 000	. 08
Foothill belt	California	5, 241, 000	. 30	(2)	
Big Bug	Arizona	1, 954, 000	. 11	(2)	
Pima	do	1, 179, 000	. 07	(2)	

[1] Not at liberty to publish figures.
[2] Less than 1,000,000 pounds.

Copper produced in some of the principal districts to the end of 1927

District or region	State	Date production began	Pounds	Per cent	Rank
Butte	Montana	1868	9, 391, 729, 000	23. 94	1
Lake Superior	Michigan	1845	7, 835, 929, 000	19. 98	2
Bisbee	Arizona	1880	3, 594, 420, 000	9. 16	3
Bingham	Utah	1896	3, 335, 577, 000	8. 50	4
Globe-Miami	Arizona	1881	2, 779, 043, 000	7. 08	5
Jerome	do	1883	(1)	(1)	6
Morenci-Metcalf	do	1873	1, 781, 228, 000	4. 54	7
Ely (Robinson)	Nevada	1908	1, 269, 565, 000	3. 24	8
Central (including Santa Rita)	New Mexico	1800	987, 392, 000	2. 52	9
Ray (Mineral Creek)	Arizona	1911	950, 132, 000	2. 42	10
Shasta County	California	1897	624, 324, 000	1. 59	11
Ajo	Arizona	(2)	[3] 521, 857, 000	1. 33	12
Ducktown	Tennessee	1850	503, 188, 000	1. 28	13
Plumas County	California	1865	199, 079, 000	. 51	14
Pioneer	Arizona	(2)	[4] 183, 887, 000	. 47	15
Tintic	Utah	1880	176, 389, 000	. 45	16
Foothill belt	California	1862	172, 211, 000	. 44	17

[1] Bureau of Mines not at liberty to publish figures for Jerome district separately in 1924–1927. The total through 1923 was 1,556,324,000 pounds.
[2] Not recorded.
[3] From 1907–1927, inclusive.
[4] From 1904–1927, inclusive.

QUANTITY AND ESTIMATED RECOVERABLE CONTENT OF COPPER-BEARING ORES

The following tables show the quantity and the estimated recoverable copper content of the ore produced by the mines of the United States in 1924 to 1927. The figures are taken from the mine reports in Mineral Resources. The close agreement between the output as reported by the smelters and the recoverable quantity as reported by the mines indicates that the estimated recoverable tenor is very close to the actual recovery. The classification of some of the complex western ores is difficult and more or less arbitrary. Under copper ores are classed not only those which contain 2.5 per cent or more of copper but those which contain less than this percentage if they are valuable chiefly for copper. Under copper-lead and copper-lead-zinc ores are classed complex ores in which copper is a valuable constituent. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead ores, zinc ores, pyritic sulphur ores, and ores concentrated for their content of other metals.

Copper produced in the United States in 1927 from ores in which copper constitutes the principal value

State	Copper ore (short tons)	Copper produced		Gold produced (fine ounces)	Silver produced (fine ounces)	Value of gold and silver per ton of ore
		Pounds	Percentage			
Alaska	645, 000	55, 343, 000	4. 29	------------	525, 100	$0. 46
Arizona	[1] 21, 674, 826	[2 3] 676, 549, 738	1. 56	159, 793. 45	5, 693, 886	. 30
California	785, 366	24, 690, 901	1. 57	16, 302. 21	383, 702	. 71
Colorado	467	54, 313	5. 82	140. 61	14, 888	24. 30
Idaho	27, 742	1, 030, 348	1. 86	794. 38	49, 623	1. 61
Michigan	8, 046, 334	177, 537, 775	1. 10	------------	97, 193	[4] . 57
Montana	2, 929, 557	[5] 212, 995, 742	3. 64	26, 991. 27	6, 158, 181	1. 38
Nevada	4, 885, 052	[6] 118, 477, 899	1. 21	46, 883. 96	183, 525	. 22
New Mexico	3, 124, 447	[7] 71, 491, 246	1. 14	14, 442. 62	122, 093	. 12
North Carolina	38, 400	5, 443, 115	7. 09	------------	------------	------------
Oregon	16, 214	486, 480	1. 50	811. 92	8, 299	1. 33
Tennessee	630, 955	14, 940, 595	1. 18	426. 47	81, 460	. 09
Utah	13, 879, 173	[8] 238, 232, 386	. 86	100, 057. 71	[9] 1, 137, 993	. 20
Vermont	4, 363	208, 224	2. 39	------------	821	. 11
Washington	37, 564	1, 684, 450	2. 24	139. 00	35, 926	. 62
Total and average	56, 725, 460	1, 599, 166, 212	1. 41	366, 783. 60	14, 492, 690	. 28

[1] Includes 6,695 tons of old tailings.

[2] Includes copper from 6,695 tons of old tailings.

[3] Excludes 4,412,437 pounds of copper from mine-water precipitates.

[4] Calculated only on ore that yielded silver.

[5] Excludes 4,515,407 pounds of copper from mine-water precipitates.

[6] Excludes 189,554 pounds of copper from mine-water precipitates.

[7] Includes 222,605 pounds of copper recovered from leaching of a waste dump.

[8] Excludes 1,221,328 pounds of copper from mine-water precipitates and 4,825,587 pounds of copper from ore leached in place.

[9] Excludes 21 ounces of silver from mine-water precipitates.

Copper produced in the United States, 1924–1926, from ores in which copper constitutes the principal value

State	1924		1925		1926	
	Copper ore (short tons)	Copper produced (pounds)	Copper ore (short tons)	Copper produced (pounds)	Copper ore (short tons)	Copper produced (pounds)
Alaska	761,779	74,071,273	860,023	73,849,029	670,000	[1] 67,778,000
Arizona	[2] 19,460,836	[3] 675,066,967	20,628,410	[4] 709,098,985	22,030,481	[5] 718,448,062
California	823,739	50,175,248	906,644	44,500,353	831,583	29,698,574
Colorado	1,803	119,315	2,193	286,410	2,126	315,152
Idaho	37,634	1,989,050	51,004	2,738,861	28,258	586,387
Michigan	5,372,572	135,662,605	7,036,751	155,157,488	7,641,682	175,381,565
Missouri			22	12,100	50	44,000
Montana	3,278,662	[6] 238,852,990	3,130,087	[4] 257,629,524	2,825,081	[5] 239,039,406
Nevada	3,505,301	[7] 73,004,373	3,923,158	[4] 78,318,519	4,888,681	[5] 100,529,055
New Mexico	2,832,901	74,494,746	3,172,291	76,101,442	3,644,936	81,242,662
North Carolina					15,150	1,468,700
Oregon	14,831	764,709	2,740	105,600	5,632	293,411
Tennessee	714,975	18,335,635	794,930	19,788,234	608,040	18,606,664
Texas					61	9,100
Utah	12,357,366	[8] 223,285,907	12,575,261	[4] 216,124,311	13,949,866	[5, 9] 239,141,740
Vermont					14,970	473,200
Washington	15,916	927,407	19,500	1,158,812	25,297	1,348,545
	49,178,315	1,566,750,225	53,103,014	1,634,869,668	57,181,894	1,674,404,223

[1] Includes a small quantity from lead ore.

[2] Includes 1,100 tons of old slag.

[3] Includes copper from 1,100 tons of old slag, but excludes 571,861 pounds of copper from mine-water precipitates.

[4] Excludes copper from mine-water precipitates, as follows: Arizona, 1,114,770 pounds; Montana, 4,804,364 pounds; Nevada, 476,540 pounds; Utah, 7,359,866 pounds.

[5] Excludes copper from mine-water precipitates, as follows: Arizona, 2,350,343 pounds; Montana, 5,044,108 pounds; Nevada, 341,843 pounds; and Utah, 1,132,550 pounds.

[6] Excludes 4,215,942 pounds of copper from mine-water precipitates, but includes copper from 141,907 tons of old tailings.

[7] Excludes 212,654 pounds of copper from ore leached in place and 108,309 pounds from mine-water precipitates.

[8] Excludes 11,668,436 pounds of copper from mine-water precipitates.

[9] Excludes 5,054,499 pounds of copper from ore leached in place.

Copper ores concentrated, leached, and smelted, and copper produced in the United States by each method in 1927

State	Ore concentrated			
	Short tons	Concentrates produced (short tons)	Copper produced (pounds)	Percentage of copper from ore
Alaska	629,736	70,935	37,959,263	3.01
Arizona	[1] 14,983,108	899,242	[2] 355,901,387	1.19
California	730,681	42,259	21,452,353	1.47
Idaho	26,562	1,922	910,599	1.71
Michigan	8,046,334	[3] 137,730	[4] 177,537,775	1.10
Montana	2,821,196	715,751	203,034,611	3.60
Nevada	4,755,216	315,630	109,193,609	1.15
New Mexico	2,982,137	157,091	64,461,564	1.08
Oregon	16,018	1,236	439,716	1.37
Tennessee	334,982	39,777	7,948,735	1.19
Utah	13,811,500	480,057	232,284,968	.84
Vermont	4,363	673	208,224	2.39
Washington	37,202	2,789	1,598,437	2.15
Total and average	49,179,035	2,865,092	1,212,931,241	1.23

[1] Includes 6,695 tons of old tailings concentrated.

[2] Includes copper from 6,695 tons of old tailings concentrated.

[3] Includes concentrates from sands.

[4] Includes copper from sands.

Copper ores concentrated, leached, and smelted, and copper produced in the United States by each method in 1927—Continued

State	Ore leached			Ore smelted		
	Short tons	Copper produced (pounds)	Percentage of copper	Short tons	Copper produced (pounds)	Percentage of copper
Alaska				15, 264	17, 383, 737	56. 94
Arizona	4, 138, 815	67, 977, 345	0. 82	2, 552, 903	252, 671, 006	4. 95
California				54, 685	3, 238, 548	2. 96
Colorado				467	54, 313	5. 82
Idaho				1, 180	119, 749	5. 07
Montana				108, 361	9, 961, 131	4. 60
Nevada				129, 836	9, 284, 290	3. 58
New Mexico	(5)	(5)	(5)	142, 310	6, 807, 077	2. 39
North Carolina				38, 400	5, 443, 115	7. 09
Oregon				196	46, 764	11. 93
Tennessee				295, 973	6, 991, 860	1. 18
Utah	(6)	(6)	(6)	67, 673	5, 947, 418	4. 39
Washington				362	86, 013	11. 88
Total and average	4, 138, 815	67, 977, 345	. 82	3, 407, 610	318, 035, 021	4. 67

[5] Continued leaching of a waste dump yielded 222,605 pounds of copper.

[6] Ore leached in place yielded 4,825,587 pounds of copper; quantity of ore unknown.

Copper ores concentrated and smelted, and copper produced in the United States by each method, 1924–1926

State	Ore concentrated					
	1924		1925		1926	
	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)
Alaska	737, 646	49, 427, 639	840, 625	45, 785, 584	649, 750	[1] 43, 182, 739
Arizona	15, 707, 477	373, 727, 904	16, 723, 155	396, 428, 008	17, 800, 347	410, 065, 457
California	619, 440	30, 183, 107	785, 280	30, 658, 693	788, 320	26, 768, 333
Idaho	27, 395	882, 154	48, 235	2, 416, 822	26, 799	455, 636
Michigan	5, 372, 572	[2] 135, 662, 605	7, 036, 751	[2] 155, 157, 488	7, 641, 682	[2] 175, 381, 565
Montana	3, 157, 349	[3] 228, 792, 355	3, 003, 379	245, 049, 804	2, 684, 887	225, 441, 875
Nevada	3, 418, 900	65, 540, 946	3, 844, 631	72, 611, 578	4, 756, 591	93, 428, 646
New Mexico	[4] 2, 706, 200	[4] 66, 776, 506	[4] 3, 002, 700	[4] 66, 973, 638	3, 523, 319	74, 035, 200
Oregon	14, 746	757, 442	2, 740	105, 600	5, 155	227, 691
Tennessee	304, 739	7, 095, 048	342, 066	8, 362, 978	286, 996	10, 796, 413
Utah	12, 345, 452	221, 264, 006	12, 538, 300	213, 446, 624	13, 880, 100	233, 465, 293
Vermont					14, 970	473, 200
Washington	15, 348	807, 221	18, 907	1, 047, 074	24, 868	1, 220, 990
	44, 427, 264	1, 180, 916, 933	48, 186, 769	1, 238, 043, 891	52, 083, 784	1, 294, 943, 038

[1] Includes a small quantity from lead ore.

[2] Includes copper from sands.

[3] Includes copper from 141,907 tons of old tailings.

[4] A quantity of copper ore from New Mexico was leached, but this may not be shown separately and is included under ore concentrated.

Copper ores concentrated and smelted, and copper produced in the United States by each method, 1924–1926—Continued

State	Ore smelted					
	1924		1925		1926	
	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)
Alaska	24, 133	24, 643, 634	19, 398	28, 063, 445	20, 250	24, 595, 261
Arizona	2, 557, 223	276, 520, 029	2, 865, 743	295, 380, 453	2, 899, 971	286, 923, 832
California	204, 299	19, 992, 141	121, 364	13, 841, 660	43, 263	2, 930, 241
Colorado	1, 803	119, 315	2, 193	286, 410	2, 126	315, 152
Idaho	10, 239	1, 106, 896	2, 769	322, 039	1, 459	130, 751
Missouri	----------	----------	22	12, 100	50	44, 000
Montana	121, 313	10, 060, 635	126, 708	12, 579, 720	140, 194	13, 597, 531
Nevada	86, 401	7, 463, 427	78, 527	5, 706, 941	132, 090	7, 100, 409
New Mexico	126, 701	7, 718, 240	169, 591	9, 127, 804	121, 617	7, 207, 462
North Carolina	----------	----------	----------	----------	15, 150	1, 468, 700
Oregon	85	7, 267	----------	----------	477	65, 720
Tennessee	410, 236	11, 240, 587	452, 864	11, 425, 256	321, 044	7, 810, 251
Texas	----------	----------	----------	----------	61	9, 100
Utah	11, 914	2, 021, 901	36, 961	2, 677, 687	69, 766	5, 676, 447
Washington	568	120, 186	593	111, 738	429	127, 555
	3, 554, 915	361, 014, 258	3, 876, 733	379, 535, 253	3, 767, 947	358, 002, 412

Copper produced from copper-lead and copper-lead-zinc ores in the United States in 1927

State	Copper-lead and copper-lead-zinc ores (short tons)	Copper produced (pounds)	Percentage of copper
Arizona	11, 930	179, 284	0. 75
California	193	13, 386	3. 47
Colorado	410	8, 284	1. 01
Idaho	40, 125	264, 399	. 33
Montana	263, 868	1, 573, 206	. 30
Nevada	25, 304	1, 323, 304	2. 61
New Mexico	2, 893	150, 708	2. 60
Utah	73, 878	2, 218, 716	1. 50
Total and average	418, 601	5, 731, 287	. 68

Copper produced from ores classed as copper-bearing (copper, copper-lead, and copper-lead-zinc ores) and total production of copper from all sources in the United States in 1927

State	From copper, copper-lead, and copper-lead-zinc ores			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Ore treated (short tons)	Copper produced (pounds)	Percentage of copper	
Alaska	645,000	55,343,000	4.29	55,343,000
Arizona[1]	21,686,756	676,729,022	1.56	682,190,547
California	785,559	24,704,287	1.57	27,133,008
Colorado[2]	877	62,597	3.57	5,670,581
Idaho	67,867	1,294,747	.95	2,173,163
Michigan	8,046,334	177,537,775	1.10	177,537,775
Missouri				451,000
Montana[1]	3,193,425	214,568,948	3.36	223,492,639
Nevada	4,910,356	119,801,203	1.22	120,259,276
New Mexico	3,127,340	71,641,954	1.15	74,251,863
North Carolina	38,400	5,443,115	7.09	5,443,115
Oregon	16,214	486,480	1.50	488,200
Pennsylvania				1,735,800
Tennessee	630,955	14,940,595	1.18	14,940,595
Texas				21,458
Utah[1]	13,953,051	240,451,102	.86	256,933,278
Vermont	4,363	208,224	2.39	208,224
Washington	37,564	1,684,450	2.24	1,685,848
Total and average	57,144,061	1,604,897,499	1.40	1,649,959,370

[1] Considerable copper was recovered from mine-water precipitates and from ores not classed as copper ores.

[2] Most of the copper from Colorado is derived from ores classed as siliceous ores and lead ores.

Copper produced from ores classed as copper-bearing (copper, copper-lead, and copper-lead-zinc ores) and total production of copper from all sources in the United States, 1924–1926

State	1924			1925			1926		
	From copper, copper-lead, and copper-lead-zinc ores		Copper from all sources, including old slags, smelter cleanings, and precipitates	From copper, copper-lead, and copper-lead-zinc ores		Copper from all sources, including old slags, smelter cleanings, and precipitates	From copper, copper-lead, and copper-lead-zinc ores		Copper from all sources, including old slags, smelter cleanings, and precipitates
	Ore treated	Copper produced		Ore treated	Copper produced		Ore treated	Copper produced	
	Short tons	*Pounds*	*Pounds*	*Short tons*	*Pounds*	*Pounds*	*Short tons*	*Pounds*	*Pounds*
Alaska	761, 808	74, 072, 232	74, 074, 207	860, 023	73, 849, 029	73, 855, 298	670, 000	[1] 67, 778, 000	67, 778, 000
Arizona [2]	19, 466, 080	675, 185, 630	677, 752, 013	20, 652, 975	709, 932, 148	713, 355, 129	22, 055, 501	719, 424, 088	723, 296, 051
California	823, 739	50, 175, 248	52, 107, 171	906, 644	44, 500, 353	46, 864, 913	831, 966	29, 720, 699	33, 466, 299
Colorado [3]	2, 228	160, 813	2, 713, 219	3, 610	363, 910	2, 360, 500	2, 223	323, 277	3, 403, 850
Idaho	42, 096	2, 043, 853	2, 738, 824	57, 279	2, 829, 338	3, 297, 443	50, 295	702, 511	1, 337, 442
Michigan	5, 372, 572	135, 662, 605	135, 662, 605	7, 036, 751	155, 157, 488	155, 157, 488	7, 641, 682	175, 381, 565	175, 381, 565
Missouri			182, 811	22	12, 100	12, 100	50	44, 000	1, 077, 000
Montana [2]	3, 487, 847	241, 072, 000	249, 152, 062	3, 325, 414	259, 012, 065	268, 910, 847	3, 049, 403	240, 689, 583	255, 372, 862
Nevada	3, 505, 304	73, 004, 862	73, 805, 323	3, 923, 283	78, 329, 945	79, 300, 224	4, 898, 832	101, 123, 855	101, 827, 937
New Mexico	2, 833, 408	74, 534, 459	74, 691, 436	3, 172, 618	76, 142, 942	76, 427, 825	3, 644, 941	81, 242, 912	81, 642, 379
North Carolina							15, 150	1, 468, 700	1, 468, 700
Oregon	14, 831	764, 709	768, 395	2, 740	105, 600	106, 325	5, 632	293, 411	296, 454
Pennsylvania			1, 114, 694			1, 035, 824			1, 018, 536
Tennessee	714, 975	18, 335, 635	18, 335, 635	794, 930	19, 788, 234	19, 788, 234	608, 040	18, 606, 664	18, 606, 664
Texas							61	9, 100	12, 620
Utah [2]	12, 357, 385	223, 291, 164	242, 138, 165	12, 575, 837	216, 135, 875	236, 486, 540	13, 949, 866	239, 141, 740	257, 464, 482
Vermont							14, 970	473, 200	473, 200
Washington	15, 916	927, 407	928, 458	19, 500	1, 158, 812	1, 159, 057	25, 297	1, 348, 545	1, 351, 890
	49, 398, 189	1, 569, 230, 617	1, 606, 165, 018	53, 331, 626	1, 637, 317, 839	1, 678, 117, 747	57, 463, 909	1, 677, 771, 850	1, 725, 275, 931

[1] Includes a small quantity of copper from lead ore.

[2] Considerable copper was recovered from mine-water precipitates and from ores not classed as copper ores.

[3] Most of the copper from Colorado is derived from ores classed as siliceous ores and lead ores.

Copper ores produced in the United States, 1918–1927, and average yield in copper, gold, and silver

Year	Smelting ores		Concentrating ores		Total				
	Short tons	Yield in copper (per cent)	Short tons	Yield in copper (per cent)	Short tons	Yield in copper (per cent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1918	6, 223, 674	4. 51	53, 937, 796	1. 18	62, 289, 069	1. 51	0. 0050	0. 328	$0. 50
1919	3, 465, 880	4. 64	30, 769, 966	1. 35	36, 121, 622	1. 65	. 0052	. 356	. 51
1920	3, 200, 509	4. 89	31, 348, 340	1. 34	36, 765, 370	1. 63	. 0047	. 331	. 46
1921	1, 235, 602	4. 77	11, 022, 544	1. 44	13, 396, 382	1. 70	. 0039	. 357	. 44
1922	2, 278, 047	5. 36	23, 258, 970	1. 43	26, 893, 247	1. 74	. 0049	. 386	. 49
1923	3, 496, 728	5. 12	40, 209, 754	1. 29	45, 519, 317	1. 58	. 0060	. 321	. 39
1924	3, 554, 915	5. 08	44, 427, 264	1. 33	49, 178, 315	1. 59	. 0063	. 325	. 35
1925	3, 876, 733	4. 90	48, 186, 769	1. 28	53, 103, 014	1. 54	. 0065	. 338	. 37
1926	3, 767, 947	4. 75	52, 083, 784	1. 24	57, 181, 894	1. 46	. 0064	. 293	. 31
1927	3, 407, 610	4. 67	49, 179, 035	1. 23	56, 725, 460	1. 41	. 0065	. 255	. 28

REVIEW BY STATES AND COMPANIES

SCOPE OF DISCUSSION

This section summarizes the conditions affecting production in the principal copper districts of the country. The tenor of the ore from each district is given, so far as it does not disclose the production of those individual companies whose figures of output have not already been published in their annual reports or elsewhere. More detailed information on the mining operations of the districts is given in the chapters on mine production.

In this report the individual companies' figures for metal output, ore reserves, metal content, and recovery in treatment, unless otherwise stated, are quoted from the published official reports of the companies. The chapter on copper in Mineral Resources for 1915 contains a map showing the location of the copper-producing districts and the metallurgical plants and also a brief discussion of the geologic occurrence of the ores in the several districts.

In 1927 the American Smelting & Refining Co. had available for dividends, after deducting all charges, taxes, bond interest, depreciation, and depletion, a net income of $15,477,769.99 compared with $17,760,721.16 in 1926; in spite of the smaller earnings the company continued the dividend on common stock at 8 per cent a year. During the year the company expended $9,932,367.32 for new undertakings and betterments without additional financing. Statistics on the company's operations for several years are given in the following table:

Operations of the American Smelting & Refining Co., 1923–1927

	1923	1924	1925	1926	1927
PRODUCTION					
Gold ounces	1, 871, 790	1, 868, 407	1, 667, 849	1, 634, 158	1, 479, 899
Silver do	94, 424, 778	92, 229, 349	82, 223, 189	85, 482, 438	80, 671, 759
Platinum and palladium do	1, 615	1, 998	(1)	(1)	(1)
Lead short tons	338, 284	412, 416	455, 261	469, 607	476, 988
Copper pounds	834, 340, 000	[2] 522, 472	[2] 502, 831	[2] 525, 897	[2] 536, 830
Zinc do	59, 813, 434	[2] 39, 450	[2] 45, 246	[2] 48, 723	[2] 52, 170

[1] Not given.

[2] Short tons.

Operations of the American Smelting & Refining Co., 1923–1927—Continued

	1923	1924	1925	1926	1927
PRODUCTION—continued					
Nickel pounds	452,388	(1)	(1)	(1)	(1)
Tin do	5,166,458	[2]486	(1)	(1)	(1)
Sulphuric acid do	66,386,000	[2]35,259	(1)	(1)	(1)
Arsenic do	14,838,789	[2]10,473	(1)	(1)	(1)
Copper sulphate do	2,060,000	(1)	(1)	(1)	(1)
By-product metals do	13,392,509	20,146,769	(1)	(1)	(1)
Sulphur dioxide do	------	------	(1)	(1)	(1)
OPERATING STATISTICS					
Number of men employed	25,477	25,765	26,401	28,612	27,363
Total wages and salaries	(1)	(1)	(1)	(1)	(1)
Average wage per day	(1)	(1)	(1)	(1)	(1)
Charge smelted short tons	5,083,655	5,160,236	5,638,730	5,433,547	4,643,306
Bullion refined do	760,602	898,390	936,346	990,295	1,004,196
Coal used do	527,985	447,710	390,981	413,351	413,366
Coke used do	480,904	486,459	517,401	508,033	492,171
Fuel oil used barrels	1,927,055	2,046,663	2,268,267	1,836,923	1,627,258
Gas used cubic feet	3,427,713,457	4,257,998,000	5,432,356,000	6,223,869,000	6,402,907,000
Ore mined short tons	2,600,249	1,551,259	1,656,212	1,875,991	2,234,880
Coal mined do	543,634	501,779	433,440	749,646	810,329
Coke produced do	171,780	206,189	323,384	360,270	366,909

[1] Not given.

[2] Short tons.

ALASKA

The output of blister copper from Alaska ores was 56,489,214 pounds in 1927, a decrease from 67,631,846 pounds in 1926. The 1927 production raised Alaska's total recorded production to 1,077,185,249 pounds, 2.75 per cent of the country's total from 1845 to 1927. Alaska remained in seventh place in 1927 among the copper-producing States. In smelter production for 1927 Alaska continued to rank seventh also, with 3.35 per cent of the total production of the country.

Prince William Sound.—The Beatson mine of the Kennecott Copper Corporation produced 448,200 tons of ore, having an average copper content of 1.571 per cent and 0.307 ounce of silver per ton. The mill treated the entire tonnage, yielding 36,422 tons of concentrates, with a copper content of 16.50 per cent—a recovery of 85.36 per cent. In 1926 the production amounted to 418,091 tons of ore, averaging 1.67 per cent of copper; it yielded 33,198 tons of concentrates, averaging 17.68 per cent of copper—a recovery of 85.94 per cent.

Copper River district.—At Kennecott 90,393 tons of ore was produced, containing an average of 12.44 per cent of copper and 2.10 ounces of silver per ton. Of this quantity 84,094 tons was treated at the mill at Kennecott and yielded 17,011 tons of concentrates, with an average content of 38.08 per cent of copper—a recovery of 94.04 per cent. In 1926, 106,933 tons of ore, containing an average of 13.07 per cent of copper, was mined at Kennecott.

ARIZONA

Arizona is the most important copper-producing State, both in production for 1927 and in total production for the country from 1845 through 1927. In 1927 Arizona produced 681,168,117 pounds of copper, 40.45 per cent of the total for the United States; Montana, the nearest competitor in total production through 1927, produced 13.37 per cent of the country's total in 1927. Arizona's total production through 1927 is 12,350,131,354 pounds, 31.48 per cent of the total United States production; Montana has produced 24.10 per cent of the United States total and Michigan 20.08 per cent. Arizona came into the lead in total production in 1920. In 1919 Montana stood first with 27.59 per cent of the total production and Arizona was a close second with 27.45 per cent. Among the six most important States in the output of copper, Arizona is the only one whose production is not made almost entirely from one district.

Bisbee district.—The Bisbee district produced more copper during the period from 1845 through 1927 than any other district in Arizona, but since 1916 the Globe-Miami district has been making considerably larger annual production. Among the country's copper-producing districts leading in total production, Bisbee, with a total recorded production through 1927 of 3,594,420,000 pounds of copper, ranks next to the Butte and Lake Superior districts. Bisbee ranked sixth in production for 1927, with 138,595,000 pounds of copper.

Copper produced in Bisbee district, Arizona, 1918–1927, in pounds

1918	160, 456, 000	1923	123, 884, 000
1919	122, 311, 000	1924	140, 630, 000
1920	118, 448, 000	1925	145, 433, 000
1921	37, 249, 000	1926	140, 668, 000
1922	79, 591, 000	1927	138, 595, 000

The Phelps Dodge Corporation, its branches and subsidiaries, produced ores in 1927 that yielded the following metals: Copper, 184,858,377 pounds; lead, 2,241,256 pounds; silver, 1,266,223 ounces; gold, 37,160 ounces; and manganese, 3,288,162 pounds. Its purchased ores yielded 3,926,320 pounds of copper, 3,322,533 pounds of lead, 619,413 ounces of silver, and 6,258 ounces of gold.

At the Copper Queen branch copper production from the limestone mines continued to decline in 1927. Development work amounted to 27,104 feet, which is about two-thirds of the 1926 footage. No new ore of any consequence was found, however, and the reserves at the end of 1927 show an appreciable shrinkage. Caving operations in the Southeast Extension mine produced more than 250,000 tons of ore with a copper content of slightly over 10,000,000 pounds. Sacramento Hill produced 1,425,607 tons of ore, of which 1,159,882 tons was milling and smelting ore, yielding 50,778,375 pounds of copper, 146,527 ounces of silver, and 6,166 ounces of gold, and the remainder was leaching ore. The copper department of the concentrator milled 1,262,494 dry tons of ore, with an average grade of 1.65 per cent of copper. This decrease of 4.7 per cent in tonnage from 1926 is due largely to reduced capacity caused by finer grinding. The ratio of concentration was raised from 6.33 into 1 in 1926 to 9.21 into 1 in 1927. The recovery of total copper was 87.53 per cent in 1927, compared with 86.93 per cent in 1926. Leaching was continued throughout the year. The test section is receiving its seventh wash and shows a total recovery of 44.05 per cent of the copper content. The percolation still continues good; the apparent recovery of the precipitation plant was 92.40 per cent.

Metals produced by Copper Queen Consolidated Mining Co., 1918–1927

Year	Ore	Copper	Silver	Gold	Lead	Zinc
	Short tons	*Pounds*	*Ounces*	*Ounces*	*Pounds*	*Pounds*
1918	771,063	90,988,156	558,433	16,409	1,234,497	----------
1919	606,386	68,614,002	492,326	10,813	9,372	----------
1920	832,172	71,443,396	486,698	8,846	243,836	----------
1921	515,632	30,610,173	495,179	4,650	4,916,418	----------
1922	389,367	47,962,123	1,132,304	11,972	8,560,525	247,793
1923	1,189,570	87,935,334	935,729	19,151	6,307,412	610,709
1924	2,022,196	109,117,018	906,521	29,850	6,094,613	----------
1925	1,940,737	116,379,978	1,079,733	32,007	7,103,853	----------
1926	1,921,021	109,269,035	907,292	35,382	3,868,259	----------
1927	1,838,665	106,351,930	781,989	32,651	4,031,433	----------

Metals produced by Copper Queen branch of Phelps Dodge Corporation in 1927

	Ore, dry weight	Gold	Silver	Copper	Lead	Manganese
Underground limestone:						
Copper—	*Short tons*	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*
Limestone	328,560	8,206	350,963	36,101,730	----------	----------
Lease	66,290	15,629	158,640	5,291,675	----------	----------
	394,850	23,835	509,603	41,393,405	----------	----------
Lead—						
Smelting	8,720	310	32,670	55,668	2,145,924	----------
Milling	6,631	453	25,474	18,577	909,197	----------
Lease	4,751	289	29,018	147,297	976,312	----------
	20,102	1,052	87,162	221,542	4,031,433	----------
Manganese:						
Lease	4,068	----------	----------	----------	----------	3,288,162
	4,068	----------	----------	----------	----------	3,288,162
Underground porphyry:						
Milling	257,653	1,598	38,608	10,756,586	----------	----------
	257,653	1,598	38,608	10,756,586	----------	----------
Sacramento Hill:						
Smelting	153,971	1,565	36,045	19,700,778	----------	----------
Milling	1,005,911	4,601	110,482	31,077,597	----------	----------
	1,159,882	6,166	146,527	50,778,375	----------	----------
Precipitates:						
Sacramento Hill	1,895	----------	89	2,878,580	----------	----------
Underground leaching	215	----------	----------	323,442	----------	----------
	2,110	----------	89	3,202,022	----------	----------
	1,838,665	32,651	781,989	106,351,930	4,031,433	3,288,162

The smelter of the Calumet & Arizona Mining Co. produced 111,865,800 pounds of blister copper, assaying 99.3 per cent, in 1927, compared with 112,588,220 pounds of blister copper in 1926. The sulphuric acid plant was operated throughout the year at full capacity, producing over 72,000 tons of 60° acid. All of this production was shipped to consumers as fast as it could be produced; most of it went to Ajo and Inspiration, where it was used largely in the New Cornelia and Inspiration leaching plants. The company did 57,224 feet of development work during 1927, as compared with 52,870.5 feet in 1926. Of this work 5,912 feet of diamond drilling was done jointly with the Shattuck Denn Mining Corporation.

Further development work was carried on with satisfactory results in the new Campbell ore body, and additional ore was discovered in the other mines. The mines at Bisbee produced 468,126 dry tons of ore, and the company shipped 477,771 tons to the smelter at Douglas. The average grade of the ore shipped was 4.95 per cent copper, as compared with 4.87 per cent in 1926.

Metals produced by Calumet & Arizona Mining Co., 1918–1927

Year	Refined copper produced (domestic)	Gold	Silver	Dividends
	Pounds	*Ounces*	*Ounces*	
1918	50, 909, 373	31, 308	906, 210	$5, 140, 062
1919	44, 991, 107	28, 530	995, 366	1, 927, 563
1920	42, 430, 847	32, 520	932, 489	2, 570, 084
1921	17, 855, 613	12, 365	419, 647	1, 285, 043
1922	30, 830, 615	23, 349	642, 174	1, 285, 047
1923	42, 166, 930	35, 693	824, 768	2, 248, 849
1924	41, 582, 030	31, 934	813, 791	1, 285, 063
1925	44, 557, 219	37, 287	832, 434	2, 571, 028
1926	45, 553, 208	35, 554	972, 650	3, 856, 542
1927	48, 164, 083	33, 556	1, 015, 450	3, 856, 542

The following figures cover the operations of the Shattuck Denn Mining Corporation during 1927:

Metallic production of the Shattuck Denn Mining Corporation in 1927

Shattuck mine:		
Copper ore mined	wet short tons	16, 526. 05
Copper ore shipped	do	16, 551. 05
Copper ore treated	dry short tons	14, 897. 41
Average moisture in copper ore	per cent	9. 49
Lead ores mined—		
Shipping ore	wet short tons	4, 737. 11
Milling ore	do	39, 558. 42
Lead ores shipped—		
Shipping ore	do	4, 737. 11
Milling ore	do	39, 688. 42
Lead ores treated—		
Shipping ore	dry short tons	4, 707. 75
Milling ore	do	38, 812. 63
Copper recovered from copper ores	pounds	2, 315, 624
Gold from copper ores	ounces	444. 60
Silver from copper ores	do	19, 673
Lead recovered—		
From ore treated	pounds	750, 840
From concentrates treated	do	2, 492, 664
Gold from lead ores and concentrates	ounces	1, 428. 15
Silver from lead ores and concentrates	do	137, 622
Denn mine:		
Copper ore mined	wet short tons	17, 619. 25
Copper ore shipped	do	17, 619. 25
Copper ore treated	dry short tons	15, 241. 66
Average moisture in copper ore	per cent	13. 24
Copper recovered	pounds	1, 830, 087
Gold from copper ores	ounces	274. 48
Silver from copper ores	do	16, 686
Lead recovered from ore milled by Phelps Dodge	pounds	1, 768, 333
Net operating cost per pound of copper	cents	11. 835
Average price per pound received for copper	do	13. 215

Metals produced by Shattuck Denn Mining Corporation, 1918-1927

[Shattuck Arizona Copper Co. prior to 1925]

Year	Copper (from copper ores)	Silver (from copper ores)	Gold (from copper ores)	Lead recovered	Copper recovered
	Pounds	*Ounces*	*Ounces*	*Pounds*	*Per cent*
1918	9, 081, 959	161, 230	1, 220	2, 420, 690	4. 83
1919	2, 111, 841	89, 724	300	4, 432, 655	4. 74
1920	2, 374, 148	73, 718	575	8, 254, 603	6. 19
1921 [1]	287, 928	12, 093	29	----------	7. 94
1922	----------	----------	----------	----------	----------
1923	3, 223, 209	157, 124	1, 349	1, 590, 682	6. 42
1924	2, 630, 185	72, 671	754	5, 244, 526	6. 44
1925	1, 828, 699	34, 246	633	3, 757, 811	5. 52
1926	3, 045, 518	46, 905	960	5, 798, 362	6. 56
1927	4, 145, 711	36, 359	719	5, 011, 837	6. 88

[1] Result of development work only. No productive operations carried on.

Globe-Miami district.—Since 1916 the Globe-Miami district has been the most important copper-producing district in Arizona, ranking second to the Bisbee district in total production for the period from 1845 through 1927. The total recorded production of copper in the Globe-Miami district through 1927 is 2,779,043,000 pounds. In total output the Globe-Miami district ranks fifth among the copper-producing districts of the country, and in output for 1927 it ranks fourth. The Globe-Miami district produced 171,167,000 pounds of copper in 1927, as compared with 175,386,000 pounds in 1926.

Copper produced in Globe-Miami district, Arizona, 1918–1927, in pounds

1918	201, 806, 000	1923	198, 426, 000
1919	171, 106, 000	1924	190, 452, 000
1920	176, 215, 000	1925	175, 272, 000
1921	76, 488, 000	1926	175, 386, 000
1922	170, 035, 000	1927	171, 167, 000

The Old Dominion Co. mined 356,697 tons of ore in 1927, compared with 362,213 tons in 1926; the grade was 3.42 per cent copper in 1927 and 3.94 per cent in 1926. The refined copper produced in 1927 aggregated 21,632,010 pounds, compared with 25,425,833 pounds in 1926. At the concentrator, which is being gradually improved to meet changing conditions in grade and content of ore, metallurgical results and operating costs showed improvement; the following data are of interest:

	1926	1927
Copper assay of heads per cent	4. 01	3. 49
Copper assay of concentrates do	19. 45	21. 10
Copper assay of tails do	. 31	. 27
Ratio of concentration	5. 23 to 1	6. 52 to 1

Metals produced by Old Dominion Co., 1918–1927 [1]

Year	Ore	Refined copper	Gold	Silver	Average grade of ore in copper
	Short tons	*Pounds*	*Ounces*	*Ounces*	*Per cent*
1918	230, 451	33, 378, 158	5, 071	184, 982	4. 52
1919	253, 686	28, 166, 396	5, 756	137, 071	4. 28
1920	249, 111	22, 854, 452	3, 484	181, 010	4. 79
1921	61, 753	7, 389, 648	1, 187	71, 155	5. 31
1922	202, 954	18, 573, 289	3, 317	122, 095	5. 14
1923	289, 695	26, 764, 801	5, 137	190, 033	4. 95
1924	294, 999	25, 400, 670	5, 531	155, 814	4. 62
1925	355, 623	27, 283, 655	5, 752	150, 782	4. 16
1926	362, 213	25, 425, 833	7, 040	149, 235	3. 94
1927	356, 697	21, 632, 010	(2)	(2)	3. 42

[1] Includes custom metals produced.

[2] Not given.

The Miami Copper Co. obtained satisfactory results during the year. Additions to the sulphide ore reserves aggregated 19,138,992 tons, averaging 0.737 per cent total copper, with 0.057 per cent soluble copper. As there was no development in the mixed ore body, these reserves were the same as those reported last year. On January 1, 1928, the ore reserves were as follows:

Ore reserves of Miami Copper Co., January 1, 1928

	Short tons	Per cent copper	
		Total	Soluble
Sulphide ore	99, 609, 480	0. 88	0. 09
Mixed ore	7, 000, 000	1. 83	1. 34
	106, 609, 480		

The mill handled 4,116,255 tons of ore, assaying 0.855 per cent copper, producing a concentrate assaying 34.257 per cent and showing an extraction of 77.64 per cent. The total refined copper produced from this ore was 53,038,218 pounds. Underground development work amounted to 72,726 feet, of which 84 per cent was done in preparing for mining that portion of the ore body served by the 720-foot haulage level, and 16 per cent was done in exploring the ore body to be served by the 1,000-foot haulage level.

Copper produced by Miami Copper Co., 1918–1927

Year	Ore	Copper content	Mill extraction	Refined copper	Dividends
	Short tons	*Per cent*	*Per cent*	*Pounds*	
1918	2, 132, 941	2. 026	71. 15	58, 407, 563	$3, 362, 013
1919	1, 698, 446	2. 040	82. 38	54, 221, 638	1, 867, 785
1920	1, 801, 958	1. 968	82. 48	55, 581, 328	1, 494, 228
1921	1, 868, 757	1. 758	85. 37	53, 311, 941	1, 494, 228
1922	2, 183, 020	1. 883	86. 36	67, 454, 447	1, 494, 228
1923	2, 380, 155	1. 697	83. 98	64, 448, 345	1, 494, 228
1924	2, 444, 079	1. 624	80. 17	60, 475, 547	1, 494, 228
1925	2, 919, 600	1. 287	72. 60	51, 851, 274	933, 893
1926	3, 793, 207	. 979	76. 77	55, 289, 174	840, 505
1927	4, 116, 255	. 855	77. 64	53, 038, 218	1, 120, 674

Milling operations of Miami Copper Co. in 1927

Ore milled	short tons	4, 116, 255
Copper in ore	per cent	0. 855
Concentrates produced	short tons	79, 805
Copper in concentrates	per cent	34. 257
	pounds	54, 678, 575
Copper recovered per ton of ore	do	13. 284
Mill extraction	per cent	77. 64

Cost of copper in concentrates f. o. b. cars at Miami, Ariz., in 1927

	Per ton of ore	Per pound of copper
Mining	$0. 41639	$0. 03231
Milling	. 41308	. 03206
General	. 16452	. 01277
	. 99399	. 07714

During 1927 the Inspiration Consolidated Copper Co. mined 5,111,108 tons of ore, as follows:

Ore mined by the Inspiration Consolidated Copper Co. in 1927

	Short tons	Per cent copper
Concentrating and smelting ores:		
Inspiration section	893, 368	0. 918
Live Oak section	1, 246, 151	1. 314
	2, 139, 519	1. 149
Leaching ores:		
Inspiration section	552, 967	1. 234
Live Oak section	1, 354, 535	1. 032
Keystone section	1, 064, 087	. 987
	2, 971, 589	1. 054
	5, 111, 108	1. 094

Of this tonnage 2,129,725 tons was shipped to the concentrator, 9,794 tons to the smelter, and 2,971,589 tons to the leaching plant. The sulphide ores produced were mined at the rate of 10.522 tons per man shift, and the ore sent to the leaching plant was mined at a rate of 12.448 tons per man shift. The total development work was distributed as follows: Inspiration section, 38,836 feet; Live Oak section, 69,531 feet; and the Keystone section, 41,570 feet—a total of 149,937 feet. In addition, the company did 8,147 feet of diamond drilling. The concentrator operated 338 days, with an average of 6.54 sections in operation, during which time 2,131,590 tons of ore was milled. The concentrates produced for the smelter averaged 37.229 per cent copper, and the flotation concentrates averaged 41.74 per cent. The average recovery of copper sulphides in the ore was 92.81 per cent. The leaching tanks were charged with a total of 2,967,949 dry tons of ore, an average of 8,504 dry tons per tank. The average extraction of the total copper was 82.197 per cent; of the oxide copper, 91.783 per cent; and of the sulphide copper, 61.834 per cent. From the total operations the company obtained 88,374,049 pounds of fine copper, consisting of 36,909,508 pounds from concentrating ores, 51,284,096 pounds from leaching ores, and 180,445 pounds from direct smelting ores.

Mill statistics, Inspiration Consolidated Copper Co., in 1927

Total ore milled	dry tons	2, 131, 590
Ore milled per day	do	6, 306. 5
Average number of sections running		6. 5
Average rate per section	tons	964
Screen analysis of feed (on 48 mesh)	per cent	1. 9
Assay mill feed	per cent of copper	1. 147
Copper in feed, oxidized	per cent	. 224
Copper assay of general tailings	do	. 274
Copper in general tailings, oxidized	do	. 206
Copper in general concentrates, smelter assay	do	37. 229
Copper in flotation concentrates	do	41. 74
Copper in table concentrates	do	6. 24
Moisture in general concentrates	do	9. 76
Ratio of concentration		41. 74
Recovery of copper (calculated from smelter assays):		
Assays only	per cent	76. 68
Assays and weights of concentrates and ore	do	77. 78
Assays and weights of concentrates and tailings	do	76. 94
Assays and weights of ore and tailings	do	76. 69
Recovery of copper sulphides	do	92. 81
Water used per ton of ore	tons	1. 395
Power used per ton of ore milled:		
Coarse crushing	kilowatt-hours	. 46
Fine grinding and concentrating	do	9. 57
Blowers for flotation air	do	2. 11
Filtering and reclaiming water	do	1. 07
Lighting	do	. 20
		13. 41
Steel balls consumed in fine grinding per ton of ore milled	pounds	1. 5801
Flotation material used per ton of ore milled:		
Lime	do	1. 38
Sodium xanthate	do	. 05
Pine oil	do	. 12
		1. 55

Copper produced by the Inspiration Consolidated Copper Co. in 1927

	Ore treated (tons)	Copper produced (pounds)
Inspiration concentrating ore	887, 344	12, 329, 671
Live Oak concentrating ore	1, 244, 246	24, 579, 837
Inspiration ore to smelter	8, 797	160, 032
Live Oak ore to smelter	997	20, 413
Inspiration leaching ore	569, 184	11, 178, 497
Live Oak leaching ore	1, 394, 263	22, 900, 238
Keystone leaching ore	1, 095, 295	17, 205, 361
	5, 200, 126	88, 374, 049
Plus net production from soluble anode inventory		84, 439
Net production available for sales		88, 458, 488

The following table shows the marked decrease in the production of the Iron Cap Copper Co. in 1927.

Metallic production of the Iron Cap Copper Co., 1922–1927

	1922	1923	1924	1925	1926	1927
Ore (dry weight)..........short tons..	69, 675	83, 931	83, 312	55, 035	67, 215	17, 933
Silver recovered..............ounces..	72, 005	75, 982	85, 680	149, 513	103, 601	66, 358
Copper recovered.............pounds..	5, 829, 122	6, 134, 162	5, 383, 059	4, 566, 501	3, 897, 780	1, 580, 189
Average price received:						
Per ounce of silver..................	$0. 9952	$0. 77826	$0. 6725	$0. 689	$0. 628	$0. 562
Per pound of copper................	$0. 13425	$0. 14446	$0. 13024	$0. 13949	$0. 13808	$0. 12856

The Arizona Commercial Mining Co. produced 65,985 dry tons of concentrating ore averaging 4.70 per cent copper during 1927, compared with 57,241 tons averaging 5.20 per cent copper in 1926, and also 532 dry tons of silica ore averaging 3.84 per cent copper in 1927, compared with 8,448 tons averaging 4.92 per cent copper in 1926—a total of 66,517 tons averaging 4.70 per cent in 1927 and 65,689 dry tons averaging 5.17 per cent in 1926. The ore produced in 1927 yielded 5,505,448 pounds of copper, 32,664 ounces of silver, and 1,157 ounces of gold.

Copper, gold, and silver produced by the Arizona Commercial Mining Co., 1919–1927

Year	Refined copper	Gold	Silver	Year	Refined copper	Gold	Silver
	Pounds	*Ounces*	*Ounces*		*Pounds*	*Ounces*	*Ounces*
1919..............	7, 280, 861	1, 310	16, 918	1924..............	7, 760, 931	1, 883	32, 634
1920..............	7, 913, 836	1, 722	31, 028	1925..............	7, 860, 866	1, 972	39, 430
1921..............	572, 616	163	3, 001	1926..............	5, 985, 607	1, 444	34, 614
1922..............	6, 220, 923	1, 585	27, 532	1927..............	5, 505, 448	1, 157	32, 664
1923..............	8, 115, 212	2, 143	37, 826				

Morenci-Metcalf district.—The copper production of the Morenci-Metcalf district decreased from 63,950,000 pounds in 1926 to 59,760,000 pounds in 1927. The total output of the district through 1927 is 1,781,228,000 pounds; it continued to rank seventh among the copper-producing districts of the United States in total output.

Copper produced in Morenci-Metcalf district, Arizona, 1918–1927, in pounds

1918..................	71, 867, 000	1923..................	28, 735, 000
1919..................	44, 868, 000	1924..................	41, 047, 000
1920..................	35, 746, 000	1925..................	59, 464, 000
1921..................	11, 420, 000	1926..................	63, 950, 000
1922..................	14, 175, 900	1927..................	59, 760, 000

The Morenci branch of the Phelps Dodge Corporation produced from its mines 1,463,591 dry tons of ore, of which 1,461,070 tons was concentrating ore and 2,521 tons was converter ore. In addition, the company handled 36,974 tons of lease ore. A total of 50,637 feet of raising and drifting was done during mining operations, of which 31,321 feet was for stope development, 19,111 feet for prospecting and development work, and 205 feet for the eighteenth-level drainage tunnel. The concentrator department treated 1,460,088 tons of ore, producing 124,557 tons of concentrates which were smelted at Clifton. The Clifton smelter treated 159,419 tons of concentrates and ore, from which 59,441,000 pounds of bullion was produced. An anode casting plant was installed during the year and put into operation late in December.

Yavapai County.—The output of copper in Yavapai County, mostly from the Jerome district, in 1927 and in several preceding years is given in the table that follows. From the beginning of operations through 1927 Jerome ranks sixth among the country's copper-producing districts. The chief producers of the district are the United Verde Copper Co. and the United Verde Extension Mining Co.

Copper produced in Yavapai County, Ariz., 1918–1927, in pounds

1918	148, 882, 695	1923	147, 718, 492
1919	80, 227, 549	1924	143, 348, 230
1920	114, 937, 080	1925	154, 017, 340
1921	26, 576, 298	1926	155, 368, 000
1922	76, 607, 502	1927	141, 642, 000

During 1927 the United Verde Extension Mining Co. produced 244,912 dry tons of ore from its mine and smelted 246,756 dry tons of company ore and 2,043 tons of custom ore. The average grade of the ore mined was 8.38 per cent copper, 0.039 ounce gold, and 1.69 ounces silver. The average grade of the company ore smelted was 8.41 per cent copper, 0.039 ounce gold, and 1.71 ounces silver. From these ores the company produced 41,301,930 pounds of copper; it sold 40,234,742 pounds. Stocks on hand January 1, 1927, were 9,720,237 pounds, and stocks on hand January 1, 1928, were 10,787,425 pounds, an increase of 1,067,188 pounds. The company did 18,900 feet of development work. The average cost of producing copper was 7.22 cents per pound, exclusive of depreciation, depletion, and taxes. The reserves are estimated at about 960,000 tons of ore, averaging a little more than 8 per cent. The company paid $3 a share in dividends—a total of $3,150,000 for 1927 and bringing their total dividends (since 1916) to date to $30,555,000.

Cost[2] of producing copper by United Verde Extension Mining Co. in 1927

	Cents per pound
Mining	2. 67
Smelting	2. 50
Freight on ore	. 10
Freight on bullion, refining, selling	1. 81
Other expenses	. 14
	7. 22

Copper produced by the United Verde Extension Mining Co., 1918–1927

Year	Ore treated	Copper produced	Silver	Gold
	Short tons	*Pounds*	*Ounces*	*Ounces*
1918	133, 535	55, 491, 077	503, 739	3, 046
1919	93, 325	28, 860, 615	272, 855	3, 169
1920	161, 617	41, 942, 700	359, 370	5, 530
1921	53, 643	12, 498, 005	112, 864	2, 328
1922	136, 980	31, 640, 714	238, 764	5, 788
1923	172, 629	41, 855, 959	257, 602	8, 992
1924	185, 858	44, 278, 947	([a])	([a])
1925	[b] 183, 309	43, 720, 324	([a])	([a])
1926	198, 911	43, 041, 576	([a])	([a])
1927	[c] 248, 799	41, 301, 930	([a])	([a])

[a] Figures not available.
[b] Includes 2,546 tons of custom concentrates smelted.
[c] Includes 2,043 tons of custom ore smelted.

[2] Exclusive of depreciation, reserve to return capital (depletion), and taxes.

The mines and plants of the United Verde Copper Co. were continuously active throughout 1927.

Ray or Mineral Creek district.—In 1927 the Ray or Mineral Creek district produced 62,860,000 pounds of copper, compared with 69,930,000 pounds in 1926. The total recorded output of the district through 1927 is 950,132,000 pounds; it continues to rank tenth among the copper-producing districts of the country.

At the Ray mines of the Nevada Consolidated Copper Co. 2,830,100 tons of copper ore was treated in 1927, a daily rate of 7,754 tons, compared with 2,957,200 tons, a daily rate of 8,102 tons, in 1926. Further data concerning the Ray branch have been blanketed in the total figures for the Ray, Chino, and Nevada properties in the report of the main company, the Nevada Consolidated Copper Co., as given under Nevada (p. 714).

Copper produced by Ray mines of the Nevada Consolidated Copper Co., 1918–1927

Year	Ore milled	Copper content	Mill recovery	Refined copper
	Short tons	*Per cent*	*Per cent*	*Pounds*
1918	3, 411, 000	1. 613	74. 92	83, 599, 160
1919	1, 621, 600	1. 814	79. 45	46, 011, 371
1920	1, 706, 928	1. 720	81. 98	47, 062, 030
1921	406, 172	1. 646	77. 82	10, 110, 131
1922	1, 178, 350	1. 587	76. 66	27, 953, 408
1923	2, 689, 800	1. 571	74. 87	61, 385, 205
1924	2, 896, 700	1. 523	78. 27	67, 017, 981
1925	3, 037, 700	1. 500	84. 45	74, 691, 091
1926	2, 957, 200	(1)	(1)	(1)
1927	2, 830, 100	(1)	(1)	(1)

[1] Not given separately. In 1926 the copper content of Ray, Nevada, and Chino production was 1.268 per cent, mill recovery 86.26 per cent, and refined copper output 231,119,539 pounds; in 1927 copper content was 1.326 per cent, mill recovery 87.92 per cent, and refined copper output 218,683,930 pounds.

Ajo district.—The New Cornelia Copper Co. mined 4,433,098 wet tons of ore and waste in 1927; 2,291,188 dry tons, containing 1.421 per cent total copper, was sent to the concentrator; 1,080,073 dry tons, containing 1.126 per cent total copper, was sent to the leaching plant; 123,212 tons of sulphide waste, containing 0.525 per cent total copper, went to the low-grade ore dumps; 845,912 tons of carbonate waste, containing 0.385 per cent total copper, went to the low-grade ore dumps; and 37,300 tons of waste went to the waste dump. The ores treated in 1927 yielded 72,932,670 pounds of copper, 200,925 ounces of silver, and 18,203 ounces of gold.

Copper produced by the New Cornelia Copper Co., 1923–1927, in pounds

	1923	1924	1925	1926	1927
Electrolytic copper	36, 063, 832	22, 746, 882	15, 979, 895	17, 405, 991	72, 932, 670
Cement copper	2, 303, 886	1, 729, 479	1, 305, 265	836, 282	
Copper from concentrates		39, 407, 932	51, 977, 126	64, 070, 190	
	38, 367, 718	63, 884, 293	69, 262, 286	82, 312, 463	72, 932, 670

Silver Bell district.—The Silver Bell district produced 2,442,000 pounds of copper in 1927, compared with 1,828,000 pounds in 1926.

Pioneer district.—The mine of the Magma Copper Co. produced 221,855 tons of ore of all classes, averaging 6.61 per cent of copper, 3.44

ounces of silver, and 0.0309 ounce of gold per ton. The net metal output for the year, after deduction of losses including those of refining, was 28,502,521 pounds of copper, 989,652 ounces of silver, and 8,528 ounces of gold, of which 977,020 pounds of copper, 203,916 ounces of silver, and 1,351 ounces of gold were produced from purchased ores. The mill heads for the year averaged 5.33 per cent of copper, the tailings averaged 0.16 per cent of copper, and the average extraction was 98.06 per cent.

CALIFORNIA

In California production of blister copper fell from 30,442,961 pounds in 1926 to 25,802,603 pounds in 1927. However, California retained eighth place among the copper-producing States in 1927 as well as eighth place in total production from the beginning of operations, the total production through 1927 being 996,291,202 pounds, or 2.54 per cent of the country's total.

Shasta district.—The Shasta district produced 4,525,000 pounds of copper in 1927, compared with 5,061,000 pounds in 1926. It has yielded a total output through 1927 of 624,324,000 pounds of copper and ranks eleventh in total production among the copper-producing districts of the country.

Foothill district.—The Foothill district produced only 578,000 pounds of copper in 1927, compared with 5,241,000 pounds in 1926; its total production through 1927 is 172,211,000 pounds.

Plumas district.—In 1927 the Plumas district produced 21,055,000 pounds of copper, compared with 22,163,000 pounds in 1926. The Engels Copper Mining Co. is the most important producer in the district. This company produced 12,121,756 pounds of copper, 125,188 ounces of silver, and 1,712 ounces of gold during 1927, thus bringing its total gross production of copper since the beginning of operations in 1914 to 133,770,644 pounds.

Cost of producing copper by Engels Copper Mining Co. in 1927

		Total	Per pound of copper
			Cents
Operating cost		$919,354.10	7.5843
Freight and smelting charges	$571,487.53		
Credit value of gold and silver recovered	99,784.01		
		471,703.52	3.8914
Operating and marketing cost		1,391,057.62	11.4757
Depreciation costs		77,968.71	.6432
Development amortization		273,249.94	2.2542
		1,742,276.27	14.3731

Operations at Superior mill in 1927

Ore milled	short tons	384,671
Average heads	per cent	1.788
Average tails	do	.193
Actual extraction	do	88.14
Concentrates produced	pounds	44,127,132
Average content of concentrates	per cent	27.47
Copper produced	pounds	12,121,756
Silver produced	ounces	125,187.55
Gold produced	do	1,712.037

Ore reserves of Engels and Superior mines, December 31, 1927, in short tons[1]

Mine	Blocked ore		Probable ore	Total
	In place	Broken in stopes		
Engels	430,195	117,354	120,247	667,796
Superior	77,144	28,604	3,490	109,238
	507,339	145,958	123,737	777,034

[1] This estimate of ore reserves represents ore that assays approximately 2 per cent in copper.

Operations at the mine of the Walker Mining Co. were continuous throughout the year; 385,819 tons of ore was broken, 340,156 tons, containing an average of 1.49 per cent of copper, was treated at the concentrator; and 19,268 tons of concentrates were produced. The average recovery was 92.696 per cent, a slight increase from an average of 92.685 per cent in 1926. Concentrates and ore, aggregating 19,407 tons and yielding 8,701,138 pounds of copper, 180,950 ounces of silver, and 12,411 ounces of gold, were sold to the smelter.

COLORADO

Although Colorado ranks tenth among the copper-producing States, both in output for 1927 and in total recorded output from the beginning of operations through 1927, a very small proportion of the copper produced is from ores classed as copper ores. The blister production of Colorado in 1927 amounted to 8,006,801 pounds, or 0.48 per cent of the total for the United States. Colorado's output of copper is derived mainly from the treatment of mixed ores in which copper is a minor constituent; these ores include lead-silver ores and pyritic ores rich in gold and silver. No important district in the State now yields ore mainly valuable for copper. The total smelter output of copper in Colorado through 1927 is 318,570,735 pounds, or 0.81 per cent of the country's total.

IDAHO

In 1927 the production of blister copper from Idaho amounted to 1,811,103 pounds, or 0.11 per cent of the total for the country, and Idaho ranked thirteenth among the copper-producing States. Idaho ranks eleventh in total production through 1927, with a total of 130,894,586 pounds.

MICHIGAN

Lake Superior district.—In the production of copper from the beginning of operations through 1927 Michigan has been surpassed only by Arizona and Montana. The smelter production through 1927 is 7,874,891,610 pounds, or 20.08 per cent of the total of 39,225,723,634 pounds for the United States. In smelter production for 1927 Michigan ranked fourth, with an output of 195,135,199 pounds, or 11.59 per cent of the country's total. The Lake Superior district ranks second only to the Butte district in total production from the beginning of operations, with a total recorded mine production through 1927 of 7,835,929,000 pounds, compared with 9,391,729,000 pounds produced by the Butte district. In 1927 the Lake Superior district ranked third in mine production, with an output of 177,538,000 pounds.

Copper ore produced in Lake Superior district, Michigan, 1918–1927

Year	Short tons	Yield of copper (per cent)	Year	Short tons	Yield of copper (per cent)
1918	11, 321, 365	0. 96	1923	5, 363, 160	1. 29
1919	7, 690, 253	1. 16	1924	5, 372, 572	1. 26
1920	5, 938, 967	1. 30	1925	7, 036, 751	1. 10
1921	3, 610, 648	1. 20	1926	7, 641, 682	1. 15
1922	4, 952, 264	1. 23	1927	8, 046, 334	1. 10

The mines of the Calumet & Hecla Consolidated Copper Co. produced 80,043,000 pounds of copper in 1927 at an average cost of 10.45 cents per pound, including cost of selling but no charges for depreciation or depletion. In addition to the above figure, the reclamation plants at Lake Linden and Hubbell produced 28,717,000 pounds of copper at an average cost sold of 6.63 cents a pound. The Calumet mill treated 681,600 tons of conglomerate rock and 211,880 tons of Osceola amygdaloid rock and the Ahmeek mill 1,151,557 tons from the Kearsarge branch and 580,081 tons from the Osceola branch. The smelter received a total of 94,552 tons of concentrates and mass during the year, all of which came from the mines and mills of the company. The smelter treated 97,317 tons of concentrates and mass from mines and mills of the company and 1,559 tons from the Isle Royale Copper Co.—a total of 98,876 tons.

Operations at the Calumet & Hecla reclamation plants at Lake Linden and Hubbell in 1927 and for the entire period of their operation

	1927	Since starting
Quantity treated .... short tons	3, 019, 000	18, 150, 000
Assay headings .... per cent	0. 574	0. 669
Assay tailings .... do	0. 093	0. 154
Refined copper produced .... pounds	28, 717, 000	187, 392, 000
Refined copper produced per ton treated .... do	9. 51	10. 32

The comparative results of the Isle Royale Copper Co. for the past four years are summarized in the following table.

Copper produced by the Isle Royale Copper Co., 1924–1927

	1924	1925	1926	1927
Rock hoisted .... short tons	425, 221	497, 124	564, 692	593, 594
Rock-house discard .... do	109, 714	118, 665	116, 945	128, 494
Rock treated .... do	315, 507	378, 459	447, 747	465, 100
Cost of mining, transportation, stamping, and taxes per ton of rock	$2. 87	$2. 62	$2. 39	$2. 50
Refined copper produced .... pounds	8, 103, 000	9, 543, 000	11, 017, 000	11, 391, 338
Refined copper per ton of rock treated .... do	25. 68	25. 22	24. 61	24. 49

The Baltic, Champion, and Trimountain mines produced 22,661,553 pounds of refined copper in 1927, of which 14,612,090 pounds was for the Copper Range Co.; one-half of the Champion output belonged to the St. Mary's Mineral Land Co. There was 592,045 tons of rock stamped which yielded, after stamping, an average of 38.27 pounds of copper per ton, compared with 36.49 pounds per ton in 1926.

Copper produced by the Champion Copper Co., 1918–1927

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound[1]	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1918	594,235	21,748,514	36.599	11.92	24.757	$2,791,800.38
1919	503,030	19,886,917	39.534	11.62	18.67	1,399,714.19
1920	321,664	13,610,324	42.419	14.40	17.17	399,772.65
1921	531,780	20,719,307	39.018	9.82	13.329	719,955.51
1922	503,593	19,583,806	38.964	9.93	14.359	890,515.16
1923	449,130	18,412,630	41.03	11.14	14.86	738,871.98
1924	457,160	20,061,630	43.88	10.49	13.76	709,276.53
1925	414,645	17,957,605	43.308	11.73	14.258	497,764.43
1926	454,654	17,658,820	38.84	10.83	13.948	597,042.27
1927	403,260	16,098,926	39.92	10.84	13.42	455,791.07

[1] Excludes depreciation and depletion.

Copper produced by the Baltic mine, 1918–1927

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound[1]	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1918	293,601	10,406,097	35.44	15.07	24.757	$1,007,551.97
1919	235,832	7,864,653	33.35	17.53	18.67	89,305.51
1920	175,357	6,613,918	37.71	18.02	17.11	[2]59,882.61
1921	195,816	7,608,847	38.86	14.15	13.078	[2]81,668.95
1922	165,804	5,329,568	32.14	16.76	13.958	[2]149,578.09
1923	137,801	4,877,248	35.51	18.42	14.626	[2]189,880.94
1924	150,101	4,769,286	31.77	15.95	13.76	[2]104,574.2[illegible]
1925	140,958	4,255,069	30.18	17.74	14.25	[2]148,517.14
1926	126,157	3,690,041	29.25	18.28	13.94	[2]160,073.52
1927	121,504	4,207,819	34.63	13.50	13.42	[2]3,120.98

[1] Excludes depreciation and depletion. [2] Deficit.

Copper produced by the Trimountain mine, 1918–1927

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound[1]	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1918	201,433	5,343,586	26.52	19.50	24.757	$338,533.03
1919	171,995	5,274,387	30.66	19.39	18.668	51,303.34
1920	116,768	3,532,025	30.24	25.51	17.115	[2]247,390.52
1921	143,172	4,341,584	30.32	18.27	13.078	[2]183,560.50
1922	130,913	4,116,100	31.44	16.47	13.95	[2]67,576.58
1923	6,273	281,482	44.87	(3)	14.62	[2]140,563.74
1924	8,159	278,259	34.10	(3)	13.76	[2]87,053.47
1925	35,465	1,065,044	30.03	(3)	14.25	[2]39,302.47
1926	63,837	2,177,416	34.11	13.43	13.94	11,253.16
1927	67,281	2,354,808	35.00	12.25	13.42	27,476.86

[1] Excludes depreciation and depletion. [2] Deficit. [3] Figures not given.

The Mohawk Mining Co. hoisted 783,499 tons of rock in 1927 and stamped 759,878 tons. The rock stamped yielded 22,124,840 pounds of copper, or an average of 29.116 pounds per ton.

Copper produced by the Mohawk Mining Co. in 1927

Rock hoisted	short tons	783, 499
Rock stamped	do	759, 878
Product of mineral	pounds	32, 148, 000
Refined copper produced	do	22, 124, 840
Yield per ton of rock treated	do	29. 116
Cost per ton of rock hoisted		$1. 764
Cost per ton of rock stamped		$1. 819
Operating cost per pound of refined copper	cents	6. 249
Cost of taxes	do	. 241
Cost of smelting, freight, and marketing product, including eastern offices' expenses	cents	1. 479
		7. 969

In 1927 the Quincy Mining Co. produced 413,000 tons of copper rock and mass, which yielded 9,718,662 pounds of refined copper (23.53 pounds per ton) and an appreciable amount of silver.

Copper produced by the Quincy Mining Co., 1924–1927

Year	Copper rock and mass	Mineral	Copper	Yield of copper per ton of rock
	Short tons	*Pounds*	*Pounds*	*Pounds*
1924	588, 100	24, 489, 920	14, 838, 633	25. 24
1925	586, 913	22, 721, 380	14, 357, 523	24. 46
1926	517, 900	20, 220, 795	13, 290, 052	25. 66
1927	413, 000	15, 336, 690	9, 718, 662	23. 53

MISSOURI

During 1927 Missouri produced only 5,041 pounds of blister copper, or less than one-tenth of its 1926 production.

MONTANA

Among the copper-producing States Montana stands second only to Arizona in total recorded output from the beginning of operations through 1927. In 1927 Montana ranked third among the copper-producing States. The smelter output of the State in 1927 was 225,208,853 pounds, or 13.37 per cent of the total for the country, and the production through 1927 is 9,453,497,508 pounds, or 24.10 per cent of the total. Unlike Arizona, which contains a number of copper-producing districts, Montana has only one outstanding district—Butte.

Butte district.—The Butte district continues as the leading district in the United States in total production of copper from the beginning of operations. Through 1927 it has produced a total of 9,391,729,000 pounds of copper, or nearly 1,600,000,000 pounds more than its nearest competitor, the Lake Superior district. In 1927 Butte produced 221,312,000 pounds, compared with 252,991,000 pounds in 1926, and yielded first place as a copper producer to the Bingham district of Utah. The Anaconda Copper Mining Co. is by far the most important producer in the Butte district. The output of the Butte district for a number of years is given in the following table.

Copper and associated metals produced in Butte district, Montana, 1918–1927

Year	Copper	Gold	Silver	Year	Copper	Gold	Silver
	Pounds		*Ounces*		*Pounds*		*Ounces*
1918	321, 104, 000	$899, 007	15, 011, 555	1923	223, 043, 000	$624, 528	11, 835, 643
1919	169, 051, 000	576, 756	10, 527, 457	1924	247, 364, 000	730, 646	11, 859, 290
1920	176, 399, 000	643, 595	10, 570, 676	1925	266, 637, 000	746, 422	11, 561, 659
1921	47, 958, 000	280, 085	4, 980, 285	1926	252, 991, 000	678, 290	11, 058, 861
1922	165, 374, 000	540, 936	10, 394, 811	1927	221, 312, 000	540, 827	9, 658, 204

The Butte mines of the Anaconda Copper Mining Co. produced 2,910,520 tons of copper ore and precipitates during 1927. The concentrator treated 2,866,785 tons of copper ore, including some custom ore. The Anaconda smelter treated 906,535 tons of cupreous material. The output of the copper refinery at Great Falls was 245,402,154 pounds of cathodes, of which 236,035,761 pounds were melted into shapes. The company spent $7,339,389.09 for new plants, equipment, and improvements; the largest item, almost one-half this amount, was spent on construction of a new electrolytic zinc plant and the remodeling of the copper concentrator and crushing plant at the reduction works at Anaconda.

Copper, gold, and silver produced by Anaconda Copper Mining Co. from company ores, 1918–1927

Year	Copper ore treated	Copper	Silver	Gold	Dividends
	Short tons	*Pounds*	*Ounces*	*Ounces*	
1918	4, 350, 446	272, 923, 031	10, 076, 748	64, 318	------------
1919	1, 794, 358	129, 781, 031	6, 744, 262	42, 526	$9, 325, 000
1920	1, 828, 380	138, 763, 065	6, 420, 026	32, 530	6, 993, 750
1921	395, 239	32, 267, 345	2, 137, 062	8, 619	------------
1922	1, 878, 162	141, 741, 235	6, 755, 212	25, 720	------------
1923	2, 735, 534	200, 779, 688	8, 568, 607	29, 726	9, 000, 000
1924	3, 017, 417	238, 247, 038	8, 345, 841	37, 689	2, 250, 000
1925	2, 750, 736	266, 373, 956	9, 054, 741	38, 390	9, 000, 000
1926	2, 570, 162	254, 302, 568	8, 226, 724	31, 764	9, 000, 000
1927 [1]	2, 866, 785	221, 300, 270	6, 638, 127	32, 674	9, 000, 000

[1] Reported in 1927 as tonnage treated in plant and production, including purchased and toll material.

The Butte & Superior Mining Co. in 1927 produced 37,953 dry tons of copper ore, the metal content of which was as follows: Copper, 2,785,353 pounds (3.71 per cent); gold, 177 ounces; silver, 212,997 ounces; lead, 159,005 pounds; and zinc, 2,217,352 pounds. The summary of ore reserves shows that copper ore is virtually exhausted.

The East Butte Copper Mining Co. produced in 1927, from its Pittsmont mine, 69,520 dry tons of ore, which averaged 4.79 per cent of copper and 5.76 ounces of silver a ton. From this ore 5,844,769 pounds of copper, 348,985 ounces of silver, and 6 ounces of gold were produced, having a gross value of $491,938.79.

Copper operations of East Butte Copper Mining Co. in 1927

Ore mined (dry weight), Pittsmont	short tons	69, 520
Average assay value, copper	per cent	4. 79
Average assay value, silver	ounces	5. 76
Copper produced	pounds	5, 844, 769
Silver produced	ounces	348, 985
Gold produced	do	6
Copper precipitates produced (dry weight)	short tons	29
Average assay value	per cent	71. 57
Copper produced	pounds	37, 304
Price per pound copper received	cents	13. 023
Cost per pound copper delivered	do	14. 719
Loss per pound	do	1. 696

NEVADA

In 1927 Nevada produced 118,298,342 pounds of copper, 7.02 per cent of the total for the country, and ranked fifth among the copper-producing States. From the beginning of operations through 1927 Nevada has produced a total of 1,423,162,126 pounds, or 3.63 per cent of the country's total, and also ranks fifth. Most of the copper produced in the State has come from the Ely (Robinson) district.

Ely (*Robinson*) *district.*—The mine production in Ely district in 1927 amounted to 107,441,000 pounds, an increase from 95,009,000 pounds in 1926. Through 1927 this district has produced a total of 1,269,565,000 pounds, or 3.24 per cent of the country's total, and ranks eighth among the copper-producing districts of the country. The Nevada Consolidated Copper Co. produces most of the output of the district and State.

Production of metals in Ely (*Robinson*) *district, Nevada, 1919–1927*

[Mine figures]

Year	Ore	Copper produced	Average yield in copper	Gold and silver per ton of ore
	Short tons	*Pounds*	*Per cent*	*Cents*
1919	2, 273, 961	47, 871, 048	1. 05	17
1920	2, 589, 546	48, 347, 828	. 93	21
1921	400, 810	10, 282, 527	1. 28	25
1922	630, 871	22, 614, 736	1. 79	19
1923	2, 833, 674	65, 928, 279	1. 16	24
1924	3, 505, 362	73, 279, 064	1. 05	21
1925	3, 922, 770	78, 627, 308	1. 00	21
1926	4, 672, 240	95, 009, 115	1. 02	18
1927	4, 488, 009	107, 441, 000	1. 20	24

At the Nevada mines of the Nevada Consolidated Copper Co. 3,679,821 dry tons of ore was taken from the shovel pits and underground workings and delivered to the concentrator. In addition to this, the company concentrated 95,972 dry tons of sulphide ore (removed from stripping operations) and handled 600,502 dry tons of custom ore, making a total of 4,376,295 tons of material that passed through the concentrator, or an average of 11,990 tons per day. The cost of milling, exclusive of depreciation and all taxes but including all other expenses, was 46.4 cents a ton for the year. From the company's Ray mines (Arizona) 2,830,100 dry tons of ore, or an average of 7,754 tons a day, was treated in the Hayden concentrator at a cost of 46.9 cents a ton. At the company's Chino mines (New Mexico) a total of 2,982,137 dry tons of ore, or an average of 8,170 tons a day, was handled at a cost of 70.2 cents a ton. At Nevada mines improvements in smelter practice and grade of concentrates made it possible to treat the whole smelter tonnage in one reverberatory furnace. The total ore production from all the company's mines in 1927 was 9,674,982 tons; of this total 9,588,030 tons (a daily average of 26,269 tons) was treated at the concentrators and 86,952 tons was crude ore shipped direct to the smelters. In addition to the company ores mentioned, 600,502 tons of contract and other custom ore was milled and 50,999 tons was smelted at the Nevada plants. The average grade of all company material milled was 1.326 per cent copper and the average recovery in concentrates was 87.92 per cent of the total copper content. From these ores the company obtained 218,683,930 pounds of copper. It reports an ore reserve of 277,483,097 tons, averaging 1.513 per cent of copper, a decrease of 2,203,334 tons from the ore reserves reported at the end of 1925. During the last two years 20,624,526 tons of ore has been mined; this shows that the new ore developed has nearly balanced the ore exploited.

Metals produced by the Nevada mines of the Nevada Consolidated Copper Co., 1918–1927

Year	Ore treated	Average assay of copper	Average extraction of copper	Refined copper produced
	Short tons	*Per cent*	*Per cent*	*Pounds*
1918	3,999,526	1.506	67.28	76,607,062
1919	2,135,425	1.599	70.49	43,971,892
1920	2,568,588	1.449	70.20	48,311,985
1921	392,645	1.49	75.23	9,362,325
1922	518,523	1.60	75.19	23,762,675
1923	2,576,388	1.31	82.90	61,573,246
1924	3,418,900	1.198	87.09	70,237,050
1925	[1]3,234,390	[1]1.21	92.24	73,653,886
1926	[2]4,568,272	(3)	(3)	(3)
1927	[4]4,376,295	(3)	(3)	(3)

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[1] In addition, 598,114 dry tons of porphyry sulphide material, averaging 0.684 per cent copper, was concentrated, giving a recovery in electrolytic copper of 9.63 pounds to a ton milled.

[2] Includes 208,143 tons of custom ore.

[3] Not given separately. In 1926 the copper content of Ray, Nevada, and Chino production was 1.268 per cent, mill recovery 86.26 per cent, and refined copper output 231,119,539 pounds; in 1927 copper content was 1.326 per cent, mill recovery 87.92 per cent, and refined copper output 218,683,930 pounds.

[4] Includes 600,502 tons of custom ore.

The Consolidated Coppermines Corporation in 1927 produced 18,891,661 pounds of copper, 10,845 ounces of gold, 27,319 ounces of silver, 14,626 pounds of lead, and 8,093 pounds of zinc. Of the copper output 10,109,103 pounds came from the Ora claim, 4,949,260 pounds from the Morris Brooks mine, 3,833,200 pounds from the Richard mine, and the remaining 98 pounds from leases.

Yerington district.—The Mason Valley Mines Co. operated without interruption throughout 1927 and produced 100,121 tons of ore from the Mason Valley group. From the Bluestone group 279,105 tons of ore was delivered to the concentrator and 12,820 tons of carbonate ore was salvaged from stripping operations and shipped to the smelter direct. The Balaklala Lease shipped 34,883 tons of heavy sulphide ore to the Thompson smelter. The concentrator operated at full capacity for 90 per cent of the total time, handling 378,901 dry tons of ore from the Mason Valley and Bluestone mines; this ore yielded 35,408 dry tons of concentrates. Marginal ore and concentrates smelted aggregated 105,884 tons, of which 80,602 tons was from company properties and properties worked under lease and 22,282 tons from outside sources. The company produced 13,691,437 pounds of copper, 17,746 ounces of gold, and 266,994 ounces of silver.

NEW MEXICO

From the beginning of operations to the end of 1927 New Mexico has produced 1,120,074,087 pounds of copper, or 2.86 per cent of the country's total output of 39,225,723,634 pounds, and ranks sixth among the copper-producing States. New Mexico also ranked sixth in production for 1927, with an output of 79,761,222 pounds of blister copper, or 4.74 per cent of the country's total. The Santa Rita district produces most of the copper from New Mexico and the Chino mines of the Nevada Consolidated Mining Co. furnish most of the district output.

Central (including Santa Rita) district.—The Central district, with a production of 987,392,000 pounds, ranks ninth among the copper-producing districts in total output from the beginning of operations through 1927. The production for several years is shown in the following table.

Copper produced in Central (including Santa Rita) district, New Mexico, 1918–1927, in pounds

1918	77, 547, 000	1923	54, 375, 000
1919	40, 359, 000	1924	66, 824, 000
1920	44, 400, 000	1925	68, 812, 000
1921	9, 138, 000	1926	75, 219, 000
1922	28, 408, 000	1927	66, 971, 000

The Nevada Consolidated Copper Co.'s Chino branch concentrated 2 982,137 dry tons of ore during 1927—a daily average of 8,170 tons. The cost of milling, exclusive of taxes and depreciation, was 70.2 cents a ton. Development work continued in the Estrella ore body which is being prepared for underground mining. The company, however, expects to obtain all its production for the next two years from power-shovel operations. The ores at the Chino mines are now being mined by power shovels at a cost of 34.8 cents a ton, exclusive of taxes and depreciation but including all other costs. The cost of stripping was 48.54 cents per cubic yard. Further details concerning this company may be found under Nevada (p. 714).

Metals produced by Chino mines of the Nevada Consolidated Copper Co., New Mexico, 1918–1927

Year	Ore milled	Copper content	Mill recovery	Refined copper produced
	Short tons	*Per cent*	*Per cent*	*Pounds*
1918	3,836,400	1.63	63.275	75,655,641
1919	1,765,200	1.82	65.67	40,488,706
1920	1,838,140	1.76	70.67	44,051,849
1921	361,660	1.70	77.36	9,137,282
1922	1,416,869	1.55	66.99	28,406,314
1923	2,785,564	1.50	66.34	54,261,228
1924	2,706,200	1.59	77.83	66,574,486
1925	3,002,700	1.42	80.54	67,385,620
1926	3,523,319	(1)	(1)	(1)
1927	2,982,137	(1)	(1)	(1)

[1] Not given separately. In 1926 the copper content of Ray, Nevada, and Chino production was 1.268 per cent, mill recovery 86.26 per cent, and refined copper output 231,119,539 pounds; in 1927 copper content was 1.326 per cent, mill recovery 87.92 per cent, and refined copper output 218,683,930 pounds.

Lordsburg district.—The Eighty-Five branch of the Calumet & Arizona Mining Co. produced 89,343 dry tons of ore in 1927. The production of the Lordsburg district for several years is given in the following statement.

Copper produced in Lordsburg district, New Mexico, 1918–1927, in pounds

[Mine figures]

1918	2,215,000	1923	4,314,000
1919	3,516,000	1924	4,928,000
1920	2,696,000	1925	5,064,000
1921	579,000	1926	4,763,000
1922	3,217,000	1927	3,933,000

TENNESSEE

In 1927 Tennessee produced 14,498,951 pounds of blister copper, or 0.86 per cent of the country's total, and ranked ninth among the copper-producing States. From the beginning of operations through 1927 Tennessee has produced approximately 502,643,000 pounds of copper, or 1.28 per cent of the total output of the country, and ranks ninth in total production also. Tennessee is the only eastern State that has made a notable output of copper. The entire production comes from the Ducktown district, in Polk County, in the extreme southeastern part of the State.

Copper produced in Ducktown district, Tennessee, 1918–1927

Year	Copper ore treated	Copper produced (smelter)	Average yield of copper	Gold and silver per ton of ore
	Short tons	*Pounds*	*Per cent*	*Cents*
1918	529,012	15,053,568	1.42	18
1919	555,018	15,629,454	1.41	21
1920	589,853	16,727,803	1.42	21
1921	564,457	15,084,294	1.34	18
1922	557,750	14,226,232	1.28	15
1923	776,477	18,721,932	1.21	12
1924	714,975	18,251,996	1.28	10
1925	794,930	19,789,234	1.24	10
1926	608,040	18,601,586	1.53	12
1927	630,955	14,498,951	1.18	9

In 1927 the Tennessee Copper Co. produced 11,063,234 pounds of copper, 291,393 tons of sulphuric acid, and 51,425 short tons of iron sinter. During 1927, 420,374 tons of ore was mined, compared with 507,954 tons in 1926; 225,480 tons of ore was smelted, compared with 321,050 tons in 1926; and 194,775 tons of ore was milled, compared with 181,580 tons in 1926. From the ore treated, 11,063,234 pounds of copper was obtained in 1927, compared with 12,566,665 pounds in 1926. The sulphuric acid plant produced 291,393 tons of 60° sulphuric acid in 1927, compared with 354,722 tons in 1926. The Burra Burra mine operated throughout the year and the Eureka mine for four months. The Eureka mine shows a decrease in ore reserves equal to the tonnage mined—20,170 tons—as there was no development work done in 1927, but at the Burra Burra mine ore in excess of that extracted was developed. The total ore reserves for all mines on January 1, 1928, were estimated at 5,683,165 tons, an increase of 8,588 tons during 1927. In the flotation plant the grade of copper concentrate was raised to 13.25 per cent copper during the last five months. At the smelter from 12,505 to 31,580 tons of ore per month was handled, according to the demand for sulphuric acid. The total ore smelted amounted to 225,480 tons.

Copper and sulphuric acid produced by Tennessee Copper Co., 1918–1927

Year	Ore treated	Copper	Sulphuric acid, 60° Baumé	Year	Ore treated	Copper	Sulphuric acid, 60° Baumé
	Short tons	*Pounds*	*Short tons*		*Short tons*	*Pounds*	*Short tons*
1918	402, 071	9, 819, 838	283, 092	1923	484, 324	12, 013, 988	299, 231
1919	413, 877	10, 414, 815	266, 627	1924	451, 777	[1] 12, 566, 576	247, 477
1920	404, 060	10, 358, 237	333, 629	1925	516, 964	[2] 13, 592, 606	329, 395
1921	302, 584	8, 018, 577	242, 743	1926	[3] 507, 954	12, 566, 665	354, 722
1922	287, 499	7, 553, 281	218, 676	1927	[3] 420, 374	11, 063, 234	291, 393

[1] Exclusive of 160,059 pounds of copper from other sources.
[2] Exclusive of 33,101 pounds of copper from other than Tennessee Copper Co. ore.
[3] Ore mined. Comparative figure for 1925 is 495,531 tons.

UTAH

The smelter production of copper in Utah increased from 259,649,158 pounds in 1926 to 267,705,597 pounds in 1927. The 1927 production was 15.90 per cent of the total output of the country and Utah ranked second among the copper-producing States. From the beginning of operations through 1927 Utah has produced a total of 3,724,963,905 pounds of copper, 9.50 per cent of the total for the country, and ranks fourth among the copper-producing States. Utah, like nearly all of the important copper-producing States, has one outstanding copper-producing district—the Bingham.

Bingham district.—The Bingham district achieved the distinction of being the largest copper-producing district in the United States in 1927. In total production from the beginning of operations through 1927 the Bingham district ranks fourth, with an output of 3,335,577,000 pounds. The outstanding producer in the Bingham district is the Utah Copper Co.

Copper produced in Bingham district, Utah, 1918–1927, in pounds

[Mine figures]

1918	211, 195, 000	1923	216, 037, 000
1919	116, 697, 000	1924	236, 181, 000
1920	110, 670, 000	1925	227, 612, 000
1921	28, 011, 000	1926	248, 975, 000
1922	91, 762, 000	1927	249, 919, 000

The mines of the Utah Copper Co. in 1927 produced and shipped to the mills 13,811,500 tons of ore, a daily average of 37,840 tons; this ore contained an average of 0.979 per cent copper, or 19.6 pounds a ton. Of the total ore milled the Magna plant treated 6,819,800 tons and the Arthur plant 6,991,700 tons. The material shipped to the smelter contained 241,678,417 pounds of copper, of which 240,964,666 pounds was in concentrates and 713,751 pounds was in precipitates from mine waters. After allowance was made for losses in smelting and refining the net production of refined copper was 233,002,661 pounds. The average cost of producing copper, after depreciation of plant and equipment and all fixed and general expenses were charged and credit was given for gold, silver, and miscellaneous earnings, was 7.54 cents a pound, compared with 7.94 cents in 1926. The ore reserves, as of December 31, 1927, are estimated to be approximately 572,000,000 tons, averaging 1.1 per cent copper.

Metals produced by Utah Copper Co. from ore milled, 1918–1927

Year	Ore milled	Copper content	Mill recovery	Copper[1]	Gold, silver, and miscellaneous income per pound of copper	Dividends (includes capital distribution)
	Short tons	*Per cent*	*Per cent*	*Pounds*	*Cents*	
1918	12, 160, 700	1. 226	65. 11	188, 092, 405	[2]0. 79	$16, 244, 900
1919	5, 538, 700	1. 26	78. 46	105, 088, 740	[2]. 83	9, 746, 940
1920	5, 556, 800	1. 16	81. 38	101, 897, 758	2. 09	9, 746, 940
1921	1, 220, 700	1. 16	83. 87	24, 511, 593	1. 15	4, 061, 225
1922	4, 364, 251	1. 26	80. 00	84, 777, 712	1. 45	3, 248, 980
1923	11, 167, 800	1. 12	80. 96	195, 142, 919	1. 313	6, 497, 960
1924	12, 126, 600	1. 07	85. 94	214, 592, 733	1. 206	6, 497, 960
1925	12, 538, 300	1. 02	86. 96	214, 162, 139	1. 36	6, 904, 083
1926	13, 880, 100	1. 01	87. 01	234, 173, 625	1. 36	8, 528, 572
1927	13, 811, 500	. 979	89. 12	233, 002, 661	1. 16	9, 746, 940

[1] Net production of refined copper, not copper content of concentrates.
[2] Exclusive of miscellaneous income.

Cost of mining, milling, and concentrating copper ore by Utah Copper Co., 1918–1927

Year	Ore (short tons)	Cost per ton			
		Mining	Transportation	Milling	Total
1918	12, 160, 700	$0. 5370	$0. 2983	$0. 9277	$1. 7630
1919	5, 538, 700	. 4900	. 3040	1. 2062	2. 0002
1920	5, 556, 800	. 4823	. 2591	1. 2472	1. 9886
1921	1, 220, 700	. 4998	. 1921	1. 1679	1. 8598
1922	4, 364, 251	. 3833	. 1612	. 8417	1. 3862
1923	11, 167, 800	. 3488	. 1088	. 6116	1. 0692
1924	12, 126, 600	. 3605	. 1308	. 5990	1. 0903
1925	12, 538, 300	. 3373	. 1151	. 5382	. 9906
1926	13, 880, 100	. 3139	. 1019	. 4843	. 9001
1927	13, 811, 500	. 3734	. 0926	. 4523	. 9183

The Ohio Copper Co., of Utah, produced 4,825,587 pounds of copper in 1927 at a cost of 10.2548 cents a pound, compared with 4,963,761 pounds at a cost of 8.9985 cents a pound in 1926.

Copper production of the Ohio Copper Co., of Utah, in 1927

	Copper produced	Cost per pound	Price per pound	Profit per pound	Operating profits
	Pounds	*Cents*	*Cents*	*Cents*	
First quarter	1,043,378	10.1363	12.8774	2.7411	$28,600.46
Second quarter	1,250,373	9.9939	12.5360	2.5421	31,786.21
Third quarter	1,328,435	10.0300	12.7279	2.6979	35,840.67
Fourth quarter	1,203,401	10.8767	13.2468	2.3701	28,521.50
	4,825,587	10.2548	12.8399	2.5851	[1] 124,748.84

[1] After adding miscellaneous income and deducting taxes, insurance, and other miscellaneous charges net profits were $46,453.75. After allowances for depreciation and depletion, a loss of $61,406.24 was deducted from surplus.

Tintic district.—The Tintic district produced 3,783,000 pounds of copper in 1927, compared with 5,226,000 pounds in 1926. From the beginning of operations through 1927 this district has yielded 176,389,000 pounds of copper. The production for several years is shown as follows:

Copper produced in Tintic district, Utah, 1918–1927, in pounds

[Mine figures]

1918	6,569,000	1923	3,033,000
1919	3,251,000	1924	3,076,000
1920	3,003,000	1925	4,627,000
1921	1,570,000	1926	5,226,000
1922	2,295,000	1927	3,783,000

REFINERY PRODUCTION

The refinery output of copper in the United States in 1927 was made by 10 plants—7 of these employed the electrolytic method and 3 employed the furnace process on Lake Superior copper.

Five of the large electrolytic refineries are on the Atlantic seaboard, and the three Lake refineries are on the Great Lakes; only two plants are west of the Great Lakes—one at Great Falls, Mont., and one at Tacoma, Wash. In addition to these refineries are the electrolytic plants at Ajo and Inspiration, Ariz., which make electrolytically refined copper directly from the liquors obtained from leaching operations; this copper is shipped as cathodes to eastern refineries, where it is melted and cast into merchant shapes, and is accounted for in the production reported from these eastern refineries. There are also numerous plants in different parts of the country that make a considerable output from old copper and from brass and other alloys of copper. The output of the regular refining plants is in the form of casting, Lake, and electrolytic copper.

Refinery production from ores of domestic and foreign origin is shown in the table on page 721. The domestic figure is the one which is to be compared with smelter production from domestic sources, the main difference being the time factor explained in the introduction to this report; the figures for refinery production include copper that was mined some three months earlier than the beginning of the calendar year and smelted probably one or two months earlier.

CASTING AND PIG COPPER

Blister copper that is low in precious metals and free enough from impurities for certain uses is refined by the furnace process and ordinarily cast into ingots. This copper is usually unfit for uses requiring a high-grade copper, such as electric transmission, brass manufacture, and rolling, but is suitable for copper castings, and a large part of it is put to that use. Lake copper excepted, a comparatively small percentage of the copper output carries so small a content of precious metals that, together with the added value of electrolytic copper, it will not more than pay for the electrolytic refining of the copper; consequently the output of casting copper is small. Some blister or pig copper low in precious metals has been exported without further treatment and is probably consumed without electrolytic refining. Some of the districts produced a rather high grade of blister copper carrying a small amount of precious metals, and it is found profitable to market some of this copper without electrolytic refining. During 1927 the production of furnace-refined new casting copper from domestic and foreign sources amounted to 4,804,000 pounds. No unrefined pig and best select copper was reported as produced in 1927.

LAKE COPPER

Lake copper, as the term is used in this report, means the output of the Lake smelters. Ordinarily a considerable proportion of this output is refined electrolytically, but most of the electrolytically refined Lake copper is mixed with furnace-refined copper or is sold as some brand of Lake copper. Since December, 1922, however, the electrolytic plant of the Calumet & Hecla Consolidated Copper Co. has not been in commission because the silver content of the copper was not sufficient to pay for its recovery. The production of Lake copper in 1927 amounted to 195,135,199 pounds.

ELECTROLYTIC COPPER

In 1927 the approximate production of electrolytic copper from primary materials of domestic origin amounted to 1,520,076,181 pounds and from materials of foreign origin to 605,748,329 pounds, and, in addition, production from secondary sources amounted to 168,766,566 pounds—a total electrolytic production of 2,294,591,076 pounds for 1927, compared with 2,305,035,677 pounds for 1926.

REFINED COPPER

The total output of new refined copper in 1927 was 2,325,763,709 pounds, an increase of 3,278,333 pounds over that in 1926. Adding to the new refined copper produced from domestic and foreign sources the imports of refined copper gives the new copper made available for consumption during the year. In the following table is shown also the production of secondary copper by the regular refineries but not the output of plants that treat only secondary material; the latter is shown in the second table on page 721.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1922–1927, in pounds

	1922	1923	1924	1925	1926	1927
Primary:						
Domestic[1]—						
Electrolytic	766, 944, 836	1, 302, 454, 492	1, 499, 223, 447	1, 533, 995, 439	1, 553, 041, 424	1, 520, 076, 181
Lake	122, 545, 126	137, 691, 306	145, 333, 227	138, 029, 764	172, 372, 304	195, 135, 199
Casting	15, 180, 723	24, 019, 197	29, 657, 925	10, 870, 144	5, 883, 433	3, 740, 819
	904, 670, 685	1, 464, 164, 995	1, 674, 214, 599	1, 682, 895, 347	1, 731, 297, 161	1, 718, 952, 199
Foreign[1]—						
Electrolytic	345, 641, 677	509, 873, 512	577, 100, 034	516, 632, 530	588, 932, 788	605, 748, 329
Casting and best select	5, 203, 597	5, 797, 109	8, 761, 377	5, 045, 947	2, 255, 427	1, 063, 181
Refinery production, new copper	1, 255, 515, 959	1, 979, 835, 616	2, 260, 076, 010	2, 204, 573, 824	2, 322, 485, 376	2, 325, 763, 709
Imports refined copper	103, 143, 142	[2] 160, 711, 227	145, 909, 968	99, 773, 546	170, 565, 766	103, 279, 082
Total new refined copper made available	1, 358, 659, 101	2, 140, 546, 843	2, 405, 985, 978	2, 304, 347, 370	2, 493, 051, 142	2, 429, 042, 791
Secondary:						
Electrolytic	100, 792, 685	85, 297, 052	104, 281, 430	140, 349, 541	163, 061, 465	168, 766, 566
Casting	45, 217, 857	46, 141, 409	50, 536, 678	58, 010, 653	62, 056, 941	41, 102, 000
	146, 010, 542	131, 438, 461	154, 818, 108	198, 360, 194	225, 118, 406	209, 868, 566
Grand total	1, 504, 669, 643	2, 271, 985, 304	2, 560, 804, 086	2, 502, 707, 564	2, 718, 169, 548	2, 638, 911, 357

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

[2] The figures of imports of refined copper from Chile in 1923 reported by the Chile Exploration Co. have been included in place of the figures of the Bureau of Foreign and Domestic Commerce for Chile, which undoubtedly are very low.

If the output of plants treating only secondary material is added to the production of the regular refining companies, the contribution from plants in the United States to the world's supply of copper for 1927 is found to be 3,306,000,000 pounds.

SECONDARY COPPER

Under secondary copper is considered material recovered from remelting old copper, copper scraps, and copper recovered from the treatment of copper alloys or alloys that are treated without the separation of the copper. A canvass of plants producing secondary copper has been made by J. P. Dunlop, of the Bureau of Mines, and the following figures are taken from his report on secondary metals in Mineral Resources.

Secondary copper recovered in the United States in 1927 and imports and exports of scrap brass and copper, in short tons

Copper as metal	201, 000
Copper in alloys other than brass	89, 000
	290, 000
Copper from new scrap (not including brass)	57, 000
Copper from old scrap (not including brass)	233, 000
	290, 000
Brass scrap remelted:	
New clean scrap	134, 000
Old scrap	152, 000
	286, 000

Copper content of brass scrap (averaging about 70 per cent copper):	
New clean scrap	93, 800
Old scrap	106, 400
	200, 200
Total copper produced from secondary sources (including copper content of brass scrap):	
From new scrap	150, 800
From old scrap	339, 400
	490, 200
Imports of scrap brass	3, 993
Imports of scrap copper	3, 739
Exports of brass ingots, scrap, and old	45, 997
Exports of scrap copper	22, 709

Refined copper from secondary sources produced in the United States, 1918–1927, in pounds

1918	705, 340, 000	1923	821, 800, 000
1919	574, 380, 000	1924	776, 600, 000
1920	624, 920, 000	1925	840, 420, 000
1921	434, 600, 000	1926	959, 600, 000
1922	671, 800, 000	1927	980, 400, 000

COPPER SULPHATE

The production of hydrous copper sulphate or bluestone by the copper refineries of the United States in 1927 was 36,039,487 pounds, having a copper content of 9,180,000 pounds, compared with 33,363,264 pounds, having a copper content of 8,498,000 pounds, in 1926.

STOCKS

Stocks of copper in the United States, January 1, 1919–1928, in pounds

Year	Refined copper	Blister and materials in process of refining	Year	Refined copper	Blister and materials in process of refining
1919	180, 000, 000	562, 600, 000	1924	264, 000, 000	432, 000, 000
1920	631, 000, 000	273, 000, 000	1925	243, 000, 000	393, 000, 000
1921	659, 000, 000	465, 000, 000	1926	124, 000, 000	432, 000, 000
1922	459, 000, 000	283, 000, 000	1927	146, 000, 000	455, 000, 000
1923	216, 000, 000	361, 000, 000	1928	171, 000, 000	401, 000, 000

IMPORTS AND EXPORTS

The imports of unmanufactured copper in 1927 amounted to 718,322,990 pounds; this quantity falls 61,118,813 pounds short of the record of 779,441,803 pounds set in 1926. Large quantities of unrefined copper were imported from the Belgian Congo, as well as from Canada, Chile, Mexico, and Peru, for refining in the United States, and large quantities of ore and concentrates were received from Canada, Chile, Cuba, Mexico, and Spain. The only important quantity of refined copper imported was from Chile. Virtually all of the ore and blister produced in Chile but not refined there is sent to the United States for treatment.

Copper (unmanufactured) imported into the United States, 1925–1927, in pounds

[General imports]

Country	Ore (copper content)	Concentrates (copper content)	Matte and regulus (copper content)	Unrefined black copper and copper in bars, pigs, or other forms	Refined in bars, plates, rods, or other forms	Old and clippings for remanufacture	Composition metal, copper chief value
1925							
Africa:							
British South	65, 055	38, 950	------------	------------	------------	------------	----------
Portuguese—							
East	383, 444	39, 897	------------	92, 769, 600	------------	------------	----------
Other	------------	10, 785	------------	------------	------------	------------	----------
Australia	900	------------	227, 231	224, 415	------------	------------	----------
Canada	41, 571, 234	2, 449, 488	96, 548	50, 500, 684	10, 110	5, 680, 470	10, 012
Chile	44, 554, 953	215, 560	265, 955	59, 800, 141	96, 170, 761	285, 823	----------
Cuba	5, 985, 806	25, 176, 103	------------	------------	------------	2, 091, 015	57, 549
France	229, 939	472, 400	87, 448	100, 439	------------	------------	----------
Germany	70, 810	128, 312	------------	1, 160	24, 640	1, 391, 205	241
Mexico	2, 220, 156	24, 771, 676	80, 000	71, 777, 809	------------	104, 454	20, 430
Peru	593, 071	82, 582	178, 750	72, 324, 746	------------	1, 129	----------
Spain	8, 897, 949	------------	------------	14, 419, 651	------------	------------	----------
United Kingdom	407, 187	107, 626	32, 259	3, 898, 193	22, 460	520, 741	112
Venezuela	------------	------------	------------	1, 068, 971	------------	------------	4, 732
Other	2, 661, 832	460, 243	764, 797	12, 447, 691	3, 545, 575	353, 629	13, 873
	107, 642, 336	53, 953, 622	1, 732, 988	379, 333, 500	99, 773, 546	10, 428, 466	106, 949
Total value	$13, 582, 361	$6, 491, 514	$212, 725	$48, 870, 358	$13, 831, 407	$1, 188, 711	$12, 086
1926							
Africa:							
British South	------------	------------	------------	52, 601, 821	------------	2, 967	----------
Portuguese—							
East	------------	20, 271	------------	83, 314, 732	910, 206	------------	----------
Other	------------	------------	------------	449, 642	------------	150	----------
Australia	248, 646	------------	140, 720	------------	------------	------------	----------
Canada	47, 609, 027	7, 963, 626	107, 655	44, 961, 092	685	6, 002, 507	135, 503
Chile	33, 074, 184	848, 861	202, 836	31, 365, 100	166, 872, 641	343, 351	----------
Cuba	5, 433, 042	14, 471, 381	------------	------------	------------	1, 926, 861	10, 980
France	1, 146, 285	37, 300	42, 114	1, 131, 955	------------	------------	----------
Germany	107, 742	623, 836	------------	216, 325	59, 387	205, 171	70, 273
Mexico	2, 862, 187	18, 821, 148	971, 943	82, 320, 581	210, 874	68, 624	----------
Peru	1, 066, 055	358, 562	99, 945	93, 907, 544	------------	6, 579	----------
Spain	13, 480, 257	------------	------------	24, 783, 133	------------	------------	----------
United Kingdom	270, 617	183, 644	250, 783	27, 743, 879	2, 069, 115	890, 199	111, 244
Venezuela	276	1, 345, 408	------------	------------	------------	1, 667	----------
Other	1, 417, 040	76, 440	313, 046	1, 002, 493	442, 858	1, 553, 513	153, 274
	106, 715, 358	44, 750, 477	2, 129, 042	443, 798, 297	170, 565, 766	11, 001, 589	481, 274
Total value	$13, 452, 075	$5, 351, 557	$261, 443	$56, 101, 041	$23, 335, 640	$1, 114, 436	$63, 769
1927							
Africa:							
Belgian Congo	1, 010	------------	------------	114, 482, 007	------------	------------	----------
Union of South Africa	------------	------------	------------	2, 697, 436	165	------------	----------
Australia	307, 397	------------	------------	------------	------------	------------	----------
Canada	40, 496, 764	10, 537, 756	------------	51, 480, 389	825, 843	5, 639, 111	----------
Chile	35, 247, 293	5, 548, 687	14, 970	63, 697, 974	100, 839, 354	272, 738	----------
Cuba	4, 263, 985	25, 108, 017	------------	241, 920	35, 496	628, 987	----------
France	123, 081	89, 808	------------	123, 309	------------	------------	300
Germany	342, 342	115, 785	68, 896	------------	557, 701	165, 932	57, 342
Mexico	6, 650, 973	25, 286, 667	1, 210, 431	82, 984, 970	------------	132, 337	----------
Peru	1, 989, 847	19, 112	84, 896	101, 870, 992	------------	73, 744	----------
Spain	8, 463, 703	------------	------------	------------	------------	------------	----------
United Kingdom	78, 848	121, 692	14, 275	19, 509, 068	1, 009, 323	72, 853	----------
Venezuela	136, 572	1, 364, 366	------------	------------	------------	37, 380	----------
Other	1, 226, 558	910	------------	1, 505, 948	11, 200	454, 530	----------
	99, 328, 373	68, 192, 800	1, 393, 468	438, 594, 013	103, 279, 082	7, 477, 612	57, 642
Total value	$10, 757, 297	$8, 106, 626	$131, 092	$51, 954, 453	$13, 105, 086	$698, 494	$14, 573

Copper (unmanufactured) imported into the United States, 1918–1927, in pounds

[General imports]

1918	575, 805, 115	1923	676, 473, 338
1919	429, 387, 594	1924	768, 813, 731
1920	485, 670, 691	1925	652, 971, 407
1921	350, 472, 611	1926	779, 441, 803
1922	541, 013, 220	1927	718, 322, 990

In 1927 the United States exported more copper to Germany than to any other country; the United Kingdom stood second in order of importance and France third. In 1926 the United Kingdom was first with France second and Germany third. The exports (in millions of pounds) from the United States to the six leading importers of United States copper in 1927 were as follows: Germany 250, United Kingdom 210, France 114, Netherlands 113, Belgium 96, and Italy 87.

Copper exported from the United States, 1926–27, in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other manufactures of copper
		Bars, ingots, or other forms	Rods						
1926									
Belgium		82,058,980	22,852	18,632		44,852	868	6,782	(1)
Canada	163,043	15,288,339	11,517,562	2,811,469	2,286,220	1,578,837	765,636	1,749,467	
China		8,167,056		36,520	15,852	26,628	69,510	280,205	
Denmark		867,701	1,343,675			1,225	67,382	28,291	
France	109,673	175,150,816	2,783,828	365,933	57	818,086	163,324	134,872	
Germany	4,610,828	153,360,480		8,745,244	2,360	504,581	37,753	4,515	
India (British)		4,415,087		22,820	3,429	222,871	625,433	195,536	
Italy		82,957,238	111,031	33,030	120	336,721	40,966	7,488	
Japan	2,295	37,343,661	1,590	5,043,581	90	9,460	656,635	65,357	
Netherlands		64,286,443	112,181	572,846	5,057	38,042	338,030	48,961	
Norway		951,333	932,458		1,313		335	23,485	
Spain		9,656,520	1,503		153		146	15,800	
Sweden	112,323	24,711,844			49	3,087	4,462	15,858	
Switzerland							2,944	43,925	
United Kingdom	466,864	180,320,237	19,733,655	1,424,703	20,417	464,157	1,444,833	792,457	
Other	126	16,588,793	8,230,072	351,334	918,101	983,643	8,822,871	15,139,530	
	5,465,152	856,124,528	44,790,407	19,426,112	3,253,218	5,032,190	13,041,128	18,552,529	(1)
Total value	$611,630	$121,231,224	$6,856,722	$2,178,330	$839,953	$1,075,143	$2,244,235	$4,816,128	$1,350,391
1927									
Belgium	5,758,076	89,498,171	639,590	246,572	35	244,134	125	17,205	(1)
Canada	30,003	15,445,902	16,639,221	5,354,847	2,014,079	1,801,415	536,436	1,692,577	
China		5,639,979		6,500	1,121	26,032	6,437	94,700	
Denmark		1,000,366	4,486,234			2,192	570	39,044	
France		111,957,106	764,249	1,155,315		347,380	25,206	140,880	
Germany		221,841,647		25,137,084	58,381	1,580,624	1,156,448	486,778	
India (British)		5,994,354	109,936	366,530		28,862	374,332	489,209	
Italy		86,270,218		325,490		561,770	769	3,932	
Japan	165	24,475,434		5,555,025	335	4,680	219,143	136,589	
Netherlands	758,792	104,600,674	2,115,711	4,188,862	661	919,921	71,166	55,194	
Norway	142,676	1,436,616	1,854,744			1,784	36,396	10,573	
Spain	7,548	3,769,759	7,295	666,679	94		50,256	56,882	
Sweden		21,875,271		157,060			1,048	10,936	
Switzerland		280,386					2,071	7,059	
United Kingdom	536,775	182,565,499	23,032,771	2,158,968	20,223	606,133	233,785	1,205,595	
Other	2,090	45,814,761	8,967,678	99,346	1,043,636	948,920	7,574,367	18,043,151	
	7,236,125	922,466,143	58,617,429	45,418,278	3,138,565	7,073,847	10,288,555	22,490,304	(1)
Total value	$784,617	$125,378,316	$8,870,322	$5,127,889	$776,739	$1,321,445	$1,689,316	$5,166,086	$1,098,886

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(1) Figures for quantity not recorded.

Copper exported from the United States, 1918–1927

Year	Pounds		Total value
	Metallic[1]	Total	
1918	744, 243, 481	747, 689, 580	$195, 840, 637
1919	515, 595, 019	516, 627, 775	117, 417, 055
1920	623, 158, 489	624, 053, 701	127, 468, 606
1921	628, 415, 714	628, 804, 750	85, 351, 928
1922	742, 755, 957	743, 039, 888	103, 874, 007
1923	828, 854, 827	829, 314, 002	129, 219, 975
1924	1, 116, 775, 136	1, 116, 915, 484	156, 645, 684
1925	1, 082, 369, 439	1, 084, 208, 532	161, 165, 820
1926[2]	960, 220, 112	965, 685, 264	139, 853, 365
1927[2]	1, 069, 493, 121	1, 076, 729, 246	149, 114, 730

[1] Exclusive of ore, concentrates, and composition metal, and in 1923–1927 of unrefined copper, figures for which are not separable from those for ore and concentrates.

[2] Exclusive of "Other manufactures of copper," valued at $1,350,391 in 1926 and $1,098,886 in 1927; quantity not recorded.

Copper sulphate (blue vitriol) exported from the United States, 1918–1927

Year	Pounds	Value	Year	Pounds	Value
1918	14, 477, 339	$1, 395, 946	1923	2, 290, 905	$130, 213
1919	9, 140, 673	928, 291	1924	2, 988, 039	142, 626
1920	3, 783, 409	306, 899	1925	6, 139, 344	285, 870
1921	3, 582, 933	217, 491	1926	4, 798, 620	231, 175
1922	5, 250, 556	256, 432	1927	6, 206, 904	320, 653

Brass and bronze exported from the United States, 1926–27

	1926		1927	
	Pounds	Value	Pounds	Value
Ingots, scrap, and old	50, 264, 811	$4, 944, 277	91, 994, 030	$8, 824, 029
Bars and rods	3, 290, 611	553, 190	2, 618, 150	410, 361
Plates and sheets	1, 464, 216	331, 717	893, 149	238, 492
Pipes and tubes	3, 557, 218	921, 519	3, 433, 324	788, 289
Pipe fittings and valves	3, 435, 398	1, 828, 056	3, 278, 304	1, 806, 776
Hardware of brass or bronze	(1)	815, 062	(1)	763, 682
Plumber's brass goods	439, 492	231, 985	713, 112	394, 139
Wire of brass or bronze	1, 266, 715	406, 876	1, 196, 029	380, 165
Brass wood screws	(2)	(2)	623, 223	157, 514
Other brass and bronze manufactures	(1)	3, 641, 248	(1)	3, 752, 566
	----------	13, 673, 930	----------	17, 516, 013

[1] Figures for quantity not recorded.

[2] Not separately recorded.

Unmanufactured brass exported from the United States, 1918–1927

[Ingots,[1] bars, rods, plates, and sheets]

Year	Pounds	Value	Year	Pounds	Value
1918	30, 989, 717	$9, 522, 934	1923	3, 465, 739	$703, 503
1919	7, 770, 671	2, 310, 561	1924	4, 529, 257	740, 993
1920	5, 810, 733	1, 671, 608	1925[1]	7, 975, 053	1, 359, 594
1921	2, 874, 762	741, 110	1926[1]	4, 754, 827	884, 907
1922	3, 660, 340	635, 449	1927[1]	3, 511, 299	648, 853

[1] Exclusive of ingots in 1925–1927, figures for which are not separable from those for "scrap and old."

CONSUMPTION

As calculated by the method shown in the following table, the quantity of new copper consumed in a year is actually the amount of new copper withdrawn from available supply on domestic account. This method of computation is not accurate, as figures on consumers' stocks are not available and can not be taken into account. In addition, much copper withdrawn on domestic account is later exported in manufactured forms. The domestic withdrawals in 1927 totaled 1,423,000,000 pounds. These are considerably lower than withdrawals in 1926, the postwar record year.

New refined copper withdrawn from total year's supply on domestic account, 1920–1927, in pounds

	1920	1921	1922	1923
Total supply of new copper	1,634,908,644	1,020,027,096	1,358,659,101	2,140,546,843
Stock at beginning of year	631,000,000	659,000,000	459,000,000	216,000,000
Total available supply	2,265,908,644	1,679,027,096	1,817,659,101	2,356,546,843
Copper exported [1]	553,070,086	609,038,352	705,025,268	[2] 792,073,512
Stock at end of year	659,000,000	459,000,000	216,000,000	264,000,000
	1,212,070,086	1,068,038,352	921,025,268	1,056,073,512
Withdrawn on domestic account	1,053,838,558	610,988,744	896,633,833	1,300,473,331

	1924	1925	1926	1927
Total supply of new copper	2,405,985,978	2,304,347,370	2,493,051,142	2,429,042,791
Stock at beginning of year	264,000,000	243,000,000	124,000,000	146,000,000
Total available supply	2,669,985,978	2,547,347,370	2,617,051,142	2,575,042,791
Copper exported [2]	1,072,243,414	1,022,335,279	900,914,935	981,083,572
Stock at end of year	243,000,000	124,000,000	146,000,000	171,000,000
	1,315,243,414	1,146,335,279	1,046,914,935	1,152,083,572
Withdrawn on domestic account	1,354,742,564	1,401,012,091	1,570,136,207	1,422,959,219

[1] Includes unrefined black blister and converter copper (bars, pigs, and other forms) (except in 1923) and refined in ingots, bars, rods, or other forms.

[2] Includes refined copper in ingots, bars, rods, or other forms, but excludes small quantity of unrefined black blister for which figures are not separable from those for ore and concentrates.

Adding the 980,400,000 pounds of secondary copper and copper in alloys produced during the year to the 1,423,000,000 pounds of new refined copper withdrawn on domestic account gives a total of about 2,403,400,000 pounds of new and old copper that was available for domestic consumption.

USES

No official data are available showing the quantity of copper that entered the different industries.

The following table shows the copper cast in different forms in 1927. It will be noted that the total is not the same as the production of refined copper.

Copper cast in different forms in the United States in 1927

Form	Pounds	Percentage
Wire bars	1,590,000,000	63.85
Ingots	245,000,000	9.84
Cakes	224,000,000	9.00
Cathodes	310,000,000	12.45
Other forms	121,000,000	4.86
	2,490,000,000	100.00

PRICES

Reports to the Bureau of Mines from copper-selling agencies in the United States indicate that 2,836,000,000 pounds of copper was delivered to domestic and foreign purchasers in 1927 at an average price of 13.1 cents a pound, or 0.9 cent a pound less than the average price obtained in 1926. The average price for copper in 1927 is considerably below the average for the 20-year period ended in 1927.

Price per pound of copper, 1900–1927, in cents[3]

1900	16.6	1907	20.0	1914	13.3	1921	12.9
1901	16.7	1908	13.2	1915	17.5	1922	13.5
1902	12.2	1909	13.0	1916	24.6	1923	14.7
1903	13.7	1910	12.7	1917	27.3	1924	13.1
1904	12.8	1911	12.5	1918	24.7	1925	14.2
1905	15.6	1912	16.5	1919	18.6	1926	14.0
1906	19.3	1913	15.5	1920	18.4	1927	13.1

Average monthly prices at New York per pound of electrolytic copper, 1920–1927, in cents, as reported by the American Metal Market Co.

[F. o. b. refinery through August, 1927; thereafter, averages represent New York refinery equivalent]

Month	1920	1921	1922	1923	1924	1925	1926	1927
January	19.02	12.85	13.60	14.66	12.59	14.79	13.94	13.12
February	18.61	12.79	12.97	15.50	12.85	14.54	14.14	12.80
March	18.36	12.23	12.84	16.96	13.65	14.17	13.98	13.21
April	18.54	12.54	12.71	16.81	13.36	13.45	13.81	12.93
May	18.28	12.83	13.29	15.63	12.93	13.50	13.77	12.74
June	17.97	12.76	13.71	14.88	12.49	13.47	13.79	12.46
July	18.61	12.35	13.90	14.59	12.57	14.07	14.00	12.63
August	18.44	11.76	13.96	14.05	13.31	14.57	14.26	13.11
September	18.04	12.10	13.88	13.60	13.08	14.46	14.19	13.05
October	16.30	12.75	13.80	12.81	13.04	14.42	14.10	13.12
November	14.39	13.16	13.79	12.89	13.70	14.48	13.79	13.45
December	13.48	13.67	14.22	12.98	14.32	13.96	13.44	13.95
Average	17.50	12.65	13.56	14.61	13.16	14.16	13.93	13.05

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[3] Weed, W. H., Copper Handbook: Vol. 11, pp. 1339, 1343, for years 1900 to 1903. U. S. Geological Survey computations for electrolytic copper since 1904. For 1916 and later years average price all marketable grades.

Average monthly quoted prices at New York per pound of electrolytic copper, 1920–1927, in cents, as reported by the Engineering and Mining Journal

Month	1920	1921	1922	1923	1924	1925	1926	1927
January	18. 918	12. 597	13. 465	14. 510	12. 401	14. 709	13. 822	12. 990
February	18. 569	12. 556	12. 864	15. 355	12. 708	14. 463	13. 999	12. 682
March	18. 331	11. 976	12. 567	16. 832	13. 515	14. 004	13. 859	13. 079
April	18. 660	12. 438	12. 573	16. 663	13. 206	13. 252	13. 706	12. 808
May	18. 484	12. 742	13. 111	15. 440	12. 772	13. 347	13. 599	12. 621
June	18. 065	12. 697	13. 575	14. 663	12. 327	13. 399	13. 656	12. 370
July	18. 576	12. 170	13. 654	14. 321	12. 390	13. 946	13. 924	12. 532
August	18. 346	11. 634	13. 723	13. 822	13. 221	14. 490	14. 174	12. 971
September	18. 144	11. 948	13. 748	13. 323	12. 917	14. 376	14. 062	12. 940
October	15. 934	12. 673	13. 632	12. 574	12. 933	14. 300	13. 862	12. 958
November	14. 257	13. 035	13. 598	12. 727	13. 635	14. 353	13. 576	13. 319
December	13. 138	13. 555	14. 074	12. 823	14. 260	13. 866	13. 302	13. 774
Average	17. 456	12. 502	13. 382	14. 421	13. 024	14. 042	13. 795	12. 920

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By C. N. Gerry[1]

SUMMARY

In 1927 the mines of Arizona produced gold, silver, copper, lead, and zinc valued at $98,790,957, a decrease of $14,745,331 compared with 1926. The average prices of silver, copper, lead, and zinc in 1927 were less than those in 1926, and the output of all metals decreased considerably. The Calumet & Arizona, United Verde Extension, New Cornelia, United Verde, Inspiration, Magma, Miami Copper, Arizona Commercial, Night Hawk Leasing, Iron Cap, and Santo Nino mining companies paid dividends amounting to $17,704,947. In addition, the Phelps Dodge Corporation, operating mines at Bisbee and Morenci, Ariz., and also in New Mexico and Mexico, paid $3,000,000, and the Nevada Consolidated Copper Co., operating mines at Ray, Ariz., McGill, Nev., and Santa Rita, N. Mex., paid $7,139,014.

The average value of the metals recovered from the ore, old tailings, slag, etc., decreased from $5.06 a ton in 1926 to $4.47 in 1927, and the average value in gold and silver from 42 cents to 36 cents a ton.

The chief producing counties in 1927 in order of total value of metals recovered were Gila, Cochise, Yavapai, Pinal, Pima, and Greenlee, all of them large copper producers. Gold was recovered chiefly from Yavapai, Cochise, Mohave, and Pima Counties. Silver came largely from Yavapai, Cochise, and Pinal Counties. Lead was recovered chiefly from Cochise, Maricopa, Graham, Pima, and Pinal Counties. Nearly all the zinc came from Mohave and Cochise Counties.

During the decade from 1918 to 1927 most of the gold was recovered from dry and siliceous ore and from copper ore; it was about evenly divided between those sources. Gold from siliceous ore has decreased, so that the output in 1927 was only about one-fifth that in 1918. On the other hand, gold from copper ore has increased; in 1927 it was 47 per cent greater than it was in 1918. Gold was also saved from lead ore and from mixed ores; very little came from placers. Silver had its source chiefly in copper ore during the 10-year period, with smaller amounts from siliceous ore and lead ore. Silver from copper ore increased from 1921 to 1926, but decreased in 1927; that from dry and siliceous ore has been decreasing, although it increased slightly in 1927.

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[1] The valuable assistance of B. N. Lowry and Paul Luff, of the Bureau of Mines, is acknowledged.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1.00	$0.247	$0.071	$0.091	1923	$0.82	$0.147	$0.070	$0.068
1919	1.12	.186	.053	.073	1924	.67	.131	.080	.065
1920	1.09	.184	.080	.081	1925	.694	.142	.087	.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1918–1927

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1918	456	13	19,038,486	262,919.43	$5,435,027	6,686,152	$6,686,152
1919	324	15	13,727,403	217,997.72	4,506,413	5,266,605	5,898,598
1920	310	8	14,920,478	231,528.65	4,786,122	5,355,303	5,837,280
1921	178	37	5,455,030	141,753.41	2,930,303	2,469,394	2,469,394
1922	285	33	10,746,045	170,479.98	3,524,134	4,531,864	4,531,864
1923	317	24	17,015,178	296,109.23	6,121,121	7,343,742	6,021,868
1924	266	9	19,820,505	235,995.74	4,878,465	6,649,276	4,455,015
1925	368	18	20,927,382	201,740.92	4,170,355	7,257,868	5,036,961
1926	362	21	22,382,685	234,010.97	4,837,436	7,381,027	4,605,761
1927	293	15	21,991,874	200,494.59	4,144,591	6,847,680	3,882,635

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	764,855,874	$188,919,401	12,503,689	$887,762	2,269,643	$206,538	$202,134,880
1919	538,100,844	100,086,757	10,203,078	540,763	1,717,000	125,341	111,157,872
1920	558,256,302	102,719,160	14,599,765	1,167,981	1,457,296	118,041	114,628,584
1921	185,034,194	23,869,411	6,541,433	294,364			29,563,472
1922	400,043,128	54,005,822	15,070,894	828,899	210,624	12,006	62,902,725
1923	618,928,602	90,982,504	16,291,548	1,140,408	519,103	35,299	104,301,200
1924	677,752,013	88,785,514	18,642,314	1,491,385			99,610,379
1925	713,355,129	101,296,428	23,876,017	2,077,213	7,332,116	557,241	113,138,198
1926	723,296,051	101,261,447	23,258,274	1,860,662	12,946,423	970,982	113,536,288
1927	682,190,547	89,366,962	19,865,961	1,251,556	2,268,960	145,213	98,790,957

GOLD

In 1927 the mine production of gold in Arizona decreased 14 per cent compared with 1926. The largest decrease, that in Mohave County, was chiefly due to the decrease in the output of gold ore from the Tom Reed mine at Oatman. There was also a large decrease in the production of gold in Cochise County, as a result of the decrease in the output of gold from the Shattuck Denn property. Of the total output of gold, 11.5 per cent was recovered from ore and old tailings treated in gold and silver mills, 25.7 per cent was recovered from ore and old tailings concentrated, and 62 per cent was from crude ore shipped for smelting. Ores treated by amalgamation yielded gold valued at $17,283 and ores and old tailings treated by cyanidation $460,605. Concentrates yielded gold valued at $1,064,843 in 1927 against $1,147,614 in 1926. The chief gold-producing districts in 1927 were the Verde in Yavapai County, the Warren in Cochise County, and the Ajo in Pima County, all of which produced copper ores, and the Union Pass in Mohave County, which yielded siliceous gold ores.

Of the mines yielding gold in Arizona in 1927 the United Verde Copper Co. reported the largest output; the Copper Queen at Bisbee was second; and the Calumet & Arizona at Bisbee, the New Cornelia at Ajo, the Katherine near Kingman, the United Verde Extension at Jerome, the Magma at Superior, the Old Dominion at Globe, the Tom Reed at Oatman, and the Morenci branch of the Phelps Dodge Corporation followed.

SILVER

The mine production of silver in Arizona in 1927 declined 7 per cent from that of 1926, when the quantity of silver produced exceeded all past records. The silver production of the State was more than 7,000,000 ounces in each of the four years 1916, 1923, 1925, and 1926, but in 1927 the output declined to 6,847,680 ounces. The decrease was chiefly due to the decrease in the output of copper ore. Good increases in the output of silver were made by the Calumet & Arizona, Copper Queen, United Verde Extension, Bunker Hill, and Reymert properties, but decreases were reported by the United Verde, Magma, Shattuck Denn, New Cornelia, Old Dominion, and Sheldon mines. The largest declines in silver output were reported in Gila and Yavapai Counties and the largest gain was in Maricopa County. Bullion from gold and silver ores contained 40,694 ounces of silver recovered by cyanidation and 746 ounces recovered by amalgamation. Concentrates yielded 26.7 per cent of the total output of silver and crude ore shipped to smelters 71.8 per cent.

Of the total silver from Arizona in 1927, 67 per cent came from the ore of the United Verde, Calumet & Arizona, Copper Queen, and Magma, each of which produced more than 700,000 ounces. Other mines that yielded more than 200,000 ounces of silver each in 1927 were the United Verde Extension, Shattuck Denn, and New Cornelia properties.

COPPER

The mine production of copper in Arizona in 1927 was 682,190,547 pounds, 5.7 per cent less than that in 1926. The largest output of copper ever recorded in the State was made in 1918, when 764,855,874 pounds was produced; the next largest output was 723,296,051 pounds in 1926. From 1904 to 1927, inclusive, the State produced

5,532,383 short tons of copper, and in 1927 the output exceeded that of Utah, the State next in order, by 425,257,269 pounds. All the large copper producers in Arizona, except Inspiration and Calumet & Arizona, reported large decreases. The average sales price of copper for 1927 used in this report is 13.1 cents a pound, a decrease from 14 cents in 1926. Of the total copper produced in the State in 1927, 52 per cent was obtained from concentrates, 37 per cent from crude ore smelted, and 10 per cent from ore leached. Of the total output from crude ore smelted, Yavapai County yielded 49.7 per cent and Cochise County 40.4 per cent. The copper from ore milled came mainly from Gila, Pinal, Pima, and Greenlee Counties. The low-grade disseminated ores in Cochise, Pima, Pinal, and Gila Counties yielded 310,226,281 pounds of copper in 1927, compared with 323,525,198 pounds in 1926. Similar low-grade copper deposits were worked in Greenlee County, so that the total production from the disseminated deposits in Arizona in 1927 was 363,983,681 pounds. In 1926 these ores altogether produced 380,103,874 pounds of copper.

Eleven properties, each yielding more than 20,000,000 pounds, produced nearly 97 per cent of the total copper from Arizona in 1927. The United Verde was first, followed by the Copper Queen, Inspiration, New Cornelia, Nevada Consolidated (Ray mine), Phelps Dodge property at Morenci, Miami, Calumet & Arizona, United Verde Extension, Magma, and Old Dominion mines. Other mines that produced more than 2,000,000 pounds of copper each were the Arizona Commercial, Shattuck Denn, and El Tiro.

LEAD

In 1927 the mine production of lead in Arizona decreased nearly 15 per cent compared with 1926. The large decrease in the shipments of lead-zinc ore from the Calumet & Arizona mine and in lead ore from the Shattuck Denn and Hilltop properties more than offset the large increases in lead from the Copper Queen, Belmont-MacNeill, and Aravaipa mines.

The largest yield of lead in Arizona in 1927 was from silver-lead ore from the Shattuck Denn and Copper Queen mines at Bisbee, Cochise County, from lead ore from the Belmont-MacNeill mine near Palo Verde, Maricopa County, and from the Aravaipa mine at Aravaipa, Graham County; these four properties yielded 67 per cent of the total lead output. Other large producers of lead were the Grand Central tailings dump in Cochise County, the Lone Mountain mine in Pima County, and the Silver Bell and Blue Bird mines in Pinal County.

ZINC

The mine production of zinc in Arizona in 1927 decreased 82 per cent from that in 1926, as a result of the substantial decrease in the shipments of lead-zinc ore from the Calumet & Arizona mine and of zinc ore from the Copper King mine. The Calumet & Arizona, Bevis Divide, Comstock Silver, and Hidden Treasure properties yielded more than 81 per cent of the total zinc. Other producers were the Twentieth Century, Copper King, and Aravaipa mines.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1927, by counties

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value		
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value
Cochise	63, 720. 76	$1, 317, 225	1. 60	$33	$1, 317, 258	2, 276, 526	$1, 290, 790
Coconino	. 48	10			10	43	24
Gila	8, 277. 59	171, 113			171, 113	365, 633	207, 314
Graham	130. 42	2, 696			2, 696	7, 248	4, 110
Greenlee	5, 203. 80	107, 572	3. 82	79	107, 651	130, 590	74, 045
Maricopa	3, 974. 39	82, 158	5. 95	123	82, 281	37, 448	21, 233
Mohave	23, 959. 12	495, 279			495, 279	88, 683	50, 283
Pima	19, 111. 18	395, 063	34. 44	712	395, 775	237, 258	134, 525
Pinal	8, 837. 05	182, 678			182, 678	1, 064, 331	603, 476
Santa Cruz	131. 19	2, 712	6. 53	135	2, 847	42, 497	24, 096
Yavapai	66, 647. 88	1, 377, 734	193. 84	4, 007	1, 381, 741	2, 584, 676	1, 465, 511
Yuma	198. 05	4, 094	56. 50	1, 168	5, 262	12, 747	7, 228
	200, 191. 91	4, 138, 334	302. 68	6, 257	4, 144, 591	6, 847, 680	3, 882, 635
Total, 1926	233, 672. 01	4, 830, 429	338. 96	7, 007	4, 837, 436	7, 381, 027	4, 605, 761

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	140, 021, 520	$18, 342, 819	12, 097, 308	$762, 130	899, 024	$57, 537	$21, 770, 534
Coconino	5, 151	675					709
Gila	173, 004, 343	22, 663, 569	475, 261	29, 941			23, 071, 937
Graham	17, 208	2, 254	1, 377, 830	86, 803	41, 878	2, 680	98, 543
Greenlee	59, 760, 067	7, 828, 569	1, 531	97			8, 010, 362
Maricopa	180, 780	23, 682	1, 796, 974	113, 209			240, 405
Mohave	37, 943	4, 971	758, 945	47, 814	1, 186, 826	75, 957	674, 304
Pima	75, 493, 619	9, 889, 664	1, 219, 456	76, 826			10, 496, 790
Pinal	91, 258, 140	11, 954, 816	1, 084, 851	68, 346			12, 809, 316
Santa Cruz	541, 460	70, 931	771, 068	48, 577			146, 451
Yavapai	141, 641, 714	18, 555, 065	110, 327	6, 951	141, 232	9, 039	21, 418, 307
Yuma	228, 602	29, 947	172, 410	10, 862			53, 299
	682, 190, 547	89, 366, 962	19, 865, 961	1, 251, 556	2, 268, 960	145, 213	98, 790, 957
Total, 1926	723, 296, 051	101, 261, 447	23, 258, 274	1, 860, 662	12, 946, 423	970, 982	113, 536, 288

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Arizona, 1926 and 1927, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1926	1927	1926	1927	1926	1927
Cochise	2, 605, 782	2, 476, 414	49	40	$1. 15	$1. 05
Coconino	26	22	1	1	. 92	1. 55
Gila	9, 850, 680	9, 798, 268	34	29	. 06	. 04
Graham	2, 599	12, 228	3	2	. 39	. 56
Greenlee	1, 555, 182	1, 495, 473	5	5	. 11	. 12
Maricopa	2, 627	15, 939	14	11	6. 49	6. 49
Mohave	106, 422	120, 262	60	49	8. 55	4. 54
Pima	3, 430, 263	3, 411, 451	42	30	. 17	. 16
Pinal	3, 227, 217	3, 076, 609	35	26	. 28	. 26
Santa Cruz	3, 557	6, 248	29	25	6. 44	4. 29
Yavapai	1, 595, 826	1, 575, 476	66	61	2. 02	1. 80
Yuma	2, 504	3, 484	24	14	10. 69	3. 25
	22, 382, 685	21, 991, 874	362	293	. 42	. 36

MINING INDUSTRY

Although Arizona produced gold, silver, copper, lead, and zinc valued at nearly $99,000,000 in 1927, the quantity and the value of the recovered metals was far less than in 1926. Although conditions were affected by decreased metal prices, the State retained its place as the leading producer of copper and continued to be a large producer of gold and silver. Pronounced progress was made in developing old and new ore bodies; new rich ore was opened, especially at the Calumet & Arizona property near Bisbee and the MacNeill mine in Maricopa County. At the Inspiration mine, Gila County, a greatly increased quantity of ore was mined for the new copper-leaching plant. Possibly the most interesting improvements were those made in milling practice and in the smelting industry.

The output of ores of all kinds except gold ore and gold and silver ore showed a general decrease, especially copper ore. Two mines reported an output of copper-lead-zinc ore in 1927; there was no output of this material in 1926. The output of copper ore in 1927 represented more than 98 per cent of the total; dry and siliceous ores and lead ore followed. The total values of the metals recovered from the ores, old tailings, slag, etc., were as follows: Dry gold ore, $603,840; dry gold and silver ore, $97,226; dry silver ore, $222,455; copper ore, $95,769,304; lead ore, $1,775,021; zinc ore, $26,686; copper-lead ore, $82,101; lead-zinc ore, $112,353; and copper-lead-zinc ore, $95,690. In addition, the placers produced gold and silver valued at $6,281. Thus the State total was $98,790,957.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Arizona, 1918–1927, with content in terms of recovered metals

DRY AND SILICEOUS ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	295, 548	149, 999. 60	917, 973	732, 519	16, 626	
1919	294, 675	135, 941. 83	1, 031, 185	731, 813	45, 642	
1920	280, 701	149, 518. 03	1, 051, 982	505, 153	46, 123	
1921	233, 201	116, 457. 77	580, 349	121, 903	56, 171	
1922	246, 286	108, 415. 11	1, 012, 558	291, 677	762, 602	
1923	556, 293	184, 458. 86	1, 968, 675	5, 567, 683	40, 870	
1924	239, 755	100, 630. 06	610, 213	1, 268, 955	30, 270	
1925	124, 990	36, 963. 83	505, 727	251, 411	1, 131, 863	
1926	139, 949	50, 685. 30	460, 826	327, 205	67, 669	
1927	151, 701	30, 418. 12	461, 321	229, 548	48, 898	
COPPER ORE						
1918	18, 647, 039	108, 750. 43	[1] 5, 347, 618	[1] 763, 766, 399	3, 465	
1919	13, 347, 182	78, 103. 32	[1] 3, 711, 052	[1] 537, 201, 237	179	
1920	14, 516, 580	76, 402. 41	[1] 3, 716, 246	[1] 557, 364, 143		
1921	5, 181, 177	21, 732. 17	[1] 1, 241, 436	[1] 184, 812, 780		
1922	10, 431, 729	57, 745. 04	[1] 2, 766, 277	[1] 399, 264, 191	2, 812	
1923	16, 331, 974	106, 691. 21	[1] 4, 269, 278	[1] 612, 303, 029	7, 282	
1924	19, 460, 836	128, 121. 07	[1] 5, 101, 837	[1] 675, 638, 828		
1925	20, 634, 428	[1] 153, 349. 54	[1] 5, 795, 173	[1] 711, 380, 756	151	
1926	22, 031, 292	167, 920. 23	[1] 5, 984, 415	[1] 720, 968, 835	244	
1927	21, 677, 976	159, 843. 83	[1] 5, 702, 270	[1] 681, 158, 850	674	

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[1] Includes metal recovered from precipitates.

Ore, old tailings, etc., sold or treated in Arizona, 1918–1927, with content in terms of recovered metals—Continued

LEAD ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1918	79, 811	3, 689. 47	362, 182	215, 746	11, 419, 226	------------
1919	76, 247	3, 701. 41	441, 739	137, 546	10, 088, 794	------------
1920	116, 269	5, 352. 21	521, 441	213, 346	13, 641, 815	------------
1921	40, 511	2, 947. 62	645, 563	89, 263	6, 435, 217	------------
1922	67, 138	3, 723. 28	744, 559	461, 980	14, 119, 456	------------
1923	115, 369	4, 514. 11	1, 090, 534	1, 035, 034	15, 991, 220	------------
1924	114, 670	6, 407. 26	912, 741	725, 567	18, 373, 553	------------
1925	127, 944	7, 807. 84	803, 153	877, 474	19, 580, 573	------------
1926	157, 854	10, 686. 05	716, 945	837, 443	19, 478, 777	------------
1927	137, 195	9, 090. 83	609, 718	609, 519	18, 408, 177	28, 518
COPPER-LEAD ORE						
1918	916	34. 83	17, 578	90, 374	221, 259	------------
1919	7, 261	24. 09	82, 593	30, 248	68, 463	------------
1920	5, 108	35. 07	65, 619	173, 660	842, 037	------------
1921	141	10. 00	1, 956	10, 248	50, 045	------------
1922	435	16. 97	8, 357	25, 280	101, 673	------------
1923	229	16. 74	15, 183	22, 856	101, 119	------------
1924	5, 244	685. 50	24, 458	118, 663	238, 491	------------
1925	24, 565	3, 264. 49	144, 567	833, 163	626, 720	------------
1926	25, 020	2, 607. 66	145, 989	976, 026	360, 759	------------
1927	4, 449	246. 97	38, 824	156, 938	546, 416	------------
ZINC ORE AND LEAD-ZINC ORE[2]						
1918	15, 172	240. 28	40, 768	50, 836	843, 113	2, 269, 643
1919	2, 038	------------	------------	------------	------------	1, 717, 000
1920	1, 820	------------	------------	------------	69, 790	1, 457, 296
1921	------------	------------	------------	------------	------------	------------
1922	457	------------	------------	------------	84, 351	210, 624
1923	1, 313	------------	------------	------------	151, 057	519, 103
1924	------------	------------	------------	------------	------------	------------
1925	15, 455	148. 80	9, 224	12, 325	2, 536, 710	7, 332, 116
1926	28, 570	1, 772. 77	72, 796	186, 542	3, 350, 825	12, 946, 423
1927 [2]	20, 553	592. 16	35, 504	35, 692	861, 796	2, 240, 442

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[2] Includes copper-lead-zinc ore in 1927, as follows: 7,481 tons, yielding 478.34 ounces of gold, 18,212 ounces of silver, 22,346 pounds of copper, 371,487 pounds of lead, and 767,893 pounds of zinc.

Ore, old tailings, etc., sold or treated in Arizona in 1927, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	77	[1] 122, 153	0. 56	27, 032. 05	13. 48	58, 599	0. 86
Dry gold and silver ore	7	[2] 11, 074	. 05	2, 090. 88	1. 04	82, 418	1. 20
Dry silver ore	39	[3] 18, 474	. 08	1, 295. 19	. 65	320, 304	4. 68
Copper ore	85	[4] 21,677,976	98. 57	159, 843. 83	79. 73	[5] 5, 702, 270	83. 27
Lead ore	95	[6] 137, 195	. 62	9, 090. 83	4. 53	609, 718	8. 90
Zinc ore	4	1, 320	. 01	10. 40	. 01	4, 434	. 06
Copper-lead ore	6	4, 449	. 02	246. 97	. 12	38, 824	. 57
Lead-zinc ore	6	11, 752	. 05	103. 42	. 05	12, 858	. 19
Copper-lead-zinc ore	2	7, 481	. 04	478. 34	. 24	18, 212	. 27
Total, lode mines	[7] 293	21, 991, 874	100. 00	200, 191. 91	99. 85	6, 847, 637	100. 00
Total, placers	15	------------	---------	302. 68	. 15	43	---------
	308	21, 991, 874	100. 00	200, 494. 59	100. 00	6, 847, 680	100. 00
Total, 1926	383	22, 382, 685	---------	234, 010. 97	---------	7, 381, 027	---------

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[1] Includes 55 tons of old tailings cyanided and 2,046 tons of old tailings sold to a smelter.

[2] Includes 460 tons of old tailings cyanided.

[3] Includes 928 tons of old tailings sold to a smelter.

[4] Includes 4,138,815 tons of ore leached, 6,695 tons of old tailings concentrated, 2,092 tons of old tailings and 957 tons of slag sold to a smelter, 74 tons of calcines, and 27 tons of matte.

[5] Includes 100 ounces of silver recovered from precipitates.

[6] Includes 8,644 tons of old tailings sold to a smelter and 11,200 tons of old tailings concentrated.

[7] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

Ore, old tailings, etc., sold or treated in Arizona in 1927, with content in terms of recovered metals—Continued

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	85, 486	0. 01	9, 724	0. 05		
Dry gold and silver ore	55, 510	. 01				
Dry silver ore	88, 552	. 01	39, 174	. 20		
Copper ore	[8] 681, 158, 850	99. 85	674			
Lead ore	609, 519	. 09	18, 408, 177	92. 66	28, 518	1. 26
Zinc ore	6, 915		15, 113	. 08	345, 294	15. 22
Copper-lead ore	156, 938	. 03	546, 416	2. 75		
Lead-zinc ore	6, 431		475, 196	2. 39	1, 127, 255	49. 68
Copper-lead-zinc ore	22, 346		371, 487	1. 87	767, 893	33. 84
	682, 190, 547	100. 00	19, 865, 961	100. 00	2, 268, 960	100. 00
Total, 1926	723, 296, 051		23, 258, 274		12, 946, 423	

[8] Includes 4,412,437 pounds of copper recovered from precipitates.

Value of metals from ore, old tailings, etc., sold or treated in Arizona in 1927, by kinds of ore

Kind of ore	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	122, 153	$558, 802	$33, 226	$11, 199	$613		$603, 840
Dry gold and silver ore	11, 074	43, 223	46, 731	7, 272			97, 226
Dry silver ore	18, 474	26, 774	181, 613	11, 600	2, 468		222, 455
Copper ore	21, 677, 976	3, 304, 265	[1] 3,233,187	[1] 89, 231, 809	43		95, 769, 304
Lead ore	137, 195	187, 924	345, 710	79, 847	1, 159, 715	$1, 825	1, 775, 021
Zinc ore	1, 320	215	2, 514	906	952	22, 099	26, 686
Copper-lead ore	4, 449	5, 105	22, 013	20, 559	34, 424		82, 101
Lead-zinc ore	11, 752	2, 138	7, 291	843	29, 937	72, 144	112, 353
Copper-lead-zinc ore	7, 481	9, 888	10, 326	2, 927	23, 404	49, 145	95, 690
	21, 991, 874	4, 138, 334	[1] 3, 882, 611	[1] 89, 366, 962	1, 251, 556	145, 213	98, 784, 676
Total, 1926	22, 382, 685	4, 830, 429	[2] 4, 605, 726	[2] 101, 261, 447	1, 860, 662	970, 982	113, 529, 246

[1] Includes value of 100 ounces of silver and 4,412,437 pounds of copper recovered from precipitates.
[2] Includes value of 58 ounces of silver and 2,350,343 pounds of copper recovered from precipitates.

GOLD ORE

Gold ore and old tailings, which represented about one-half of 1 per cent of the total output of ore, old tailings, etc., were reported from 77 mines in 1927. This material yielded on the average $4.57 in gold and 0.48 ounce of silver to the ton, with a little copper and lead, and had a value of $4.94 in metals a ton. Mohave County, with 28 mines producing gold ore and old tailings, reported the largest output of gold ore; it was followed by Yavapai County, with 24 mines. The largest producers of gold ore were the Katherine mine in the Union Pass district near Kingman and the Tom Reed mine at Oatman, both in Mohave County, and the Congress mine at Congress, Yavapai County.

GOLD AND SILVER ORE

Seven mines in five counties reported the production of gold and silver ore and old tailings in 1927. This material yielded on the average $3.90 in gold and 7.44 ounces of silver to the ton, with a little copper, and had a value of $8.78 in metals a ton. Nearly all the gold and silver ore came from the Bunker Hill property at Tombstone, Cochise County.

SILVER ORE

A total of 39 mines in 8 counties reported the output of silver ore and old tailings in 1927. This material yielded on the average $1.45 in gold and 17.34 ounces of silver to the ton, with a little copper and lead, and was valued at $12.04 in metals a ton. The largest quantities came from the Reymert mine near Superior, Pinal County, and from the Commonwealth property near Pearce, Cochise County.

COPPER ORE

Of the copper ore, old tailings, etc., produced in 1927 at 85 mines in Arizona, 18,238,008 tons came from six low-grade disseminated deposits worked by five companies, whose mines are near Globe, Ray, Ajo, Bisbee, and Morenci. The crude copper ore mined and smelted directly (without concentration) amounted to 2,552,903 tons, and most of it was sulphide material. The total copper ore, etc., sold or treated in 1927 yielded on the average 15 cents in gold and 0.26 ounce of silver to the ton and 1.56 per cent of copper, and was valued at $4.39 in metals a ton, compared with $4.89 in 1926.

LEAD ORE

The output of lead ore and old tailings in 1927 was reported from 95 mines in 11 counties. This material yielded on the average $1.37 in gold and 4.44 ounces of silver to the ton, 6.71 per cent of lead, and a little copper, and was valued at $12.94 in metals a ton. More than 74 per cent of the total lead ore and old tailings came from 20 properties in Cochise County, and more than half of it was from mines near Bisbee, in the Warren district. The largest output of lead ore came from the property of the Shattuck Denn Mining Corporation near Bisbee, Cochise County; the output of the Copper Queen mine, also at Bisbee, ranked second.

ZINC ORE

Four mines in Cochise, Graham, Mohave, and Yavapai Counties made the output of 1,320 tons of zinc ore in 1927, valued at $20.22 in metals a ton. Most of the ore came from the Twentieth Century mine near Chloride, Mohave County.

COPPER-LEAD ORE

Six mines in three counties made the output of 4,449 tons of copper-lead ore in 1927, nearly all of which came from the Sheldon mine near Walker, Yavapai County. The total copper-lead ore yielded on the average $1.15 in gold and 8.73 ounces of silver to the ton, 1.76 per cent of copper, and 6.14 per cent of lead, and was valued at $18.45 in metals a ton.

LEAD-ZINC ORE

Lead-zinc ore (11,752 tons) was reported from six mines in Cochise and Mohave Counties in 1927. This ore, which decreased considerably in quantity, yielded on the average $9.56 in metals a ton. Nearly all the lead-zinc ore came from the Hidden Treasure property at Chloride, Mohave County, and from the Calumet & Arizona property at Bisbee, Cochise County.

COPPER-LEAD-ZINC ORE

The output of 7,481 tons of copper-lead-zinc ore in 1927 was reported from the Banner & Prince George and Bevis Divide (Arizona Premier) properties near Kingman, Mohave County. The ore yielded on the average $1.32 in gold and 2.43 ounces of silver to the ton, 2.48 per cent of lead, 5.13 per cent of zinc, and 0.15 per cent of copper, and was valued at $12.79 in metals a ton.

Ore, old tailings, etc., sold or treated in Arizona in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	2,049	860.29	10,011	26,940	4,584	
Gila	47	61.09	109	675		
Greenlee	33	31.20	364	1,020		
Maricopa	1,773	789.00	296	798	2,255	
Mohave	[1] 101,036	23,193.62	30,315	1,916		
Pima	1,939	670.81	7,987	405	2,761	
Pinal	104	95.82	67			
Yavapai	[2] 14,732	1,192.93	8,547	49,073	124	
Yuma	440	137.29	903	4,659		
	122,153	27,032.05	58,599	85,486	9,724	
Total, 1926	111,083	47,586.24	69,992	231,657	24,892	

DRY GOLD AND SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Cochise	[3] 10,975	2,068.96	81,482	54,836		
Graham	4	5.50	217			
Pima	1	2.22	43			
Yavapai	19	3.00	180	179		
Yuma	75	11.20	496	495		
	11,074	2,090.88	82,418	55,510		
Total, 1926	9,440	1,713.32	92,574	32,131	2,805	

DRY SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Cochise	[4] 5,857	814.60	58,826	11,486	38,074	
Gila	[5] 461	8.84	8,069	14,450	925	
Mohave	445	105.42	13,603	922		
Pima	25	.08	1,017	305	175	
Pinal	9,138	142.55	169,804	41,024		
Santa Cruz	32		1,186	184		
Yavapai	1,516	223.49	59,855	20,181		
Yuma	1,000	.21	7,944			
	18,474	1,295.19	320,304	88,552	39,174	
Total, 1926	19,426	1,385.74	298,260	63,417	39,972	

[1] Includes 55 tons of old tailings cyanided.
[2] Includes 2,046 tons of old tailings sold to a smelter.
[3] Includes 460 tons of old tailings cyanided.
[4] Includes 500 tons of old tailings sold to a smelter.
[5] Includes 428 tons of old tailings sold to a smelter.

Ore, old tailings, etc., sold or treated in Arizona in 1927, by counties, with content in terms of recovered metals—Continued

COPPER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	2,353,682	54,638.92	[6] 1,642,872	[6] 139,555,170	469	
Coconino	22	.46	43	5,151		
Gila	[7] 9,796,866	8,125.63	348,231	[6] 172,983,024	31	
Greenlee	1,495,436	5,169.60	130,221	59,759,044	124	
Maricopa	39	4.30	134	8,381		
Mohave	39	14.06	1,040	3,170		
Pima	[8] 3,406,971	18,233.51	211,727	75,474,931		
Pinal	[9] 3,065,237	8,566.88	870,761	[6] 91,185,838		
Santa Cruz	3,136	79.40	2,406	522,089	50	
Yavapai	[10] 1,554,981	64,964.95	2,494,231	[6] 141,438,819		
Yuma	1,567	46.12	604	223,233		
	21,677,976	159,843.83	5,702,270	681,158,850	674	
Total, 1926	22,031,292	167,920.23	5,984,415	720,968,835	244	

LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Cochise	[11] 101,787	5,338.01	483,335	373,088	11,764,932	
Gila	894	82.04	9,224	6,194	474,305	
Graham	12,193	124.90	7,031	17,208	1,375,830	28,518
Greenlee	4	3.00	3	3	1,407	
Maricopa	14,127	3,181.10	37,018	171,601	1,794,719	
Mohave	490	56.29	9,155	3,158	201,511	
Pima	[12] 2,515	204.53	16,477	17,978	1,216,520	
Pinal	1,619	1.60	3,991	2,357	593,563	
Santa Cruz	2,978	36.68	37,291	15,239	756,959	
Yavapai	186	59.43	3,401	2,478	56,021	
Yuma	402	3.25	2,792	215	172,410	
	137,195	9,090.83	609,718	609,519	18,408,177	28,518
Total, 1926	157,854	10,686.05	716,945	837,443	19,478,777	

ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Cochise	57					32,000
Graham	31				2,000	13,360
Mohave	1,026	8.00	3,500			158,702
Yavapai	206	2.40	934	6,915	13,113	141,232
	1,320	10.40	4,434	6,915	15,113	345,294
Total, 1926	5,533	66.24	33,932	129,808	319,907	4,428,233

COPPER-LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Pinal	511	30.20	19,708	28,921	491,288	
Santa Cruz	102	15.11	1,612	3,948	14,059	
Yavapai	3,836	201.66	17,504	124,069	41,069	
	4,449	246.97	38,824	156,938	546,416	
Total, 1926	25,020	2,607.66	145,989	976,026	360,759	

[6] Includes metal recovered from precipitates.

[7] Includes 3,058,742 tons of ore leached, 2,092 tons of old tailings sold to a smelter, and 74 tons of calcines.

[8] Includes 6,695 tons of old tailings concentrated and 1,080,073 tons of ore leached.

[9] Includes 957 tons of slag sold to a smelter.

[10] Includes 27 tons of matte.

[11] Includes 11,200 tons of old tailings concentrated and 8,503 tons of old tailings sold to a smelter.

[12] Includes 141 tons of old tailings sold to a smelter.

Zinc ore, lead-zinc ore, and zinc concentrates (as marketed from Arizona mines and mills) sold to smelters in 1927

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized zinc ore	Cochise and Graham	88	56,700	32.22	45,360
Sulphide zinc ore	Mohave and Yavapai	232	192,863	41.57	163,934
Sulphide lead-zinc ore	Cochise and Mohave	2,052	1,090,254	26.57	872,527
Zinc concentrates	Mohave	1,373	1,386,289	50.48	1,187,139
		3,745	2,726,106	36.40	2,268,960

METALLURGIC INDUSTRY

In Arizona the general tendency toward concentration, smelting, and leaching has been pronounced. Of the total ore, old tailings, etc., shipped or treated in 1927, nearly 69 per cent was concentrated, 12 per cent was first-class ore shipped for smelting, and 19 per cent was ore leached. Less than one-half of 1 per cent of the total was treated by amalgamation or cyanidation and it came chiefly from Mohave County.

Nine smelting plants within the State, all but one treating copper ore, were active throughout the year, and considerable ore from Arizona was treated at El Paso, Tex. Although the price of copper was not high and there was some curtailment, the Inspiration and the Calumet & Arizona properties increased their output. The new lead stack of the Phelps Dodge Corporation at Douglas was blown in in August and regular shipments of lead bullion started in September.

Fifty-six milling plants in Arizona were active in 1927. Thirty-one were concentration plants, of which 6 used tables and flotation devices, 17 used flotation alone, and 8 used jigs and tables without flotation cells. Twelve mills were equipped for amalgamation, 9 for cyanidation, 1 for amalgamation and concentration, and 3 for leaching. The New Cornelia leaching plant at Ajo operated regularly and treated more than 1,000,000 tons of carbonate ore by this method. At Inspiration the new 7,500-ton leaching plant treated about 3,000,000 tons of mixed oxide and sulphide ores. Heap leaching was continued at Bisbee.

Concentration reduced 15,119,697 tons of ore and old tailings to 917,579 tons of concentrates, and gold and silver mills produced 14 tons of lead concentrates.

Of the first-class material smelted, copper ore constituted the largest part. The mines of the Verde district, Yavapai County, and those of the Warren district, Cochise County, together produced nearly 92 per cent of the copper ore smelted. Dry and siliceous ore ranked second in quantity and was followed by lead ore and lead-zinc ore.

Miscellaneous material other than ore and old tailings milled and crude ore smelted consisted of 14,768 tons of old slag, calcines, matte, and old tailings shipped for smelting, 4,138,815 tons of ore leached, and mine-water precipitates. This material yielded 1,191.50 ounces of gold, 57,932 ounces of silver, 72,672,512 pounds of copper, and

692,723 pounds of lead, valued in all at $9,621,218. The copper came chiefly from ore leached and the gold, silver, and lead chiefly from old tailings.

Mine production of metals at gold and silver mills in Arizona in 1927, by counties

County	Ore and old tailings treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Cochise	1	460	6.09	1	33.96	1,183
Gila	20	----------	9.19	3	----------	----------
Maricopa	[1] 1,460	----------	131.40	43	467.50	125
Mohave	100,690	55	249.39	592	21,776.00	28,253
Pima	166	----------	134.33	29	2.22	43
Pinal	103	----------	93.92	28	----------	----------
Yavapai	465	----------	135.93	38	1.87	3,146
Yuma	1,240	----------	75.83	12	.21	7,944
	[1] 104,145	515	836.08	746	22,281.76	40,694
Total, 1926	[2] 98,695	----------	1,521.37	1,026	37,766.38	50,014

[1] Also yielded 14 tons of lead concentrate; metal yield included in following table.

[2] Also yielded 1 ton of siliceous concentrate and 8 tons of copper concentrate; metal yield included in following table.

Mine production of metals from Arizona concentrates in 1927

BY COUNTIES

	Ore and old tailings to concentrating mills		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	1,337,836	11,200	148,127	7,022.35	411,824	34,383,775	6,550,736	----------
Gila	6,660,276	--------	194,659	7,698.83	245,315	115,980,575	19,133	----------
Graham	12,000	--------	1,788	121.90	6,709	15,583	1,234,213	28,518
Greenlee	1,460,088	--------	124,047	4,671.52	107,301	53,757,400	----------	----------
Maricopa	14,126	--------	[1] 3,310	3,214.10	37,056	171,716	1,796,563	----------
Mohave	18,306	--------	2,001	582.28	31,870	29,647	575,592	1,158,621
Pima	2,293,709	6,695	96,878	18,732.74	208,860	56,239,521	----------	----------
Pinal	3,009,856	--------	277,000	6,548.15	590,017	80,804,362	2,730	----------
Santa Cruz	1,626	--------	374	20.87	11,657	6,739	203,636	----------
Yavapai	293,546	--------	69,286	2,878.74	175,743	14,941,972	41,460	----------
Yuma	433	--------	123	20.30	1,959	3,510	101,439	----------
	15,101,802	17,895	[1] 917,593	51,511.78	1,828,311	356,334,800	10,525,502	1,187,139
Total, 1926	17,902,147	24,423	[1] 1,074,178	55,515.82	1,943,130	411,197,814	7,467,850	1,700,342

BY KINDS OF CONCENTRATES

Dry and siliceous	274	803.86	8,603	710	124	----------
Copper	900,095	43,789.92	1,427,192	356,024,308	----------	----------
Lead	15,521	6,453.54	370,214	282,916	10,217,266	----------
Zinc	1,373	151.76	9,666	7,893	55,294	1,187,139
Copper-lead	330	312.70	12,636	18,973	252,818	----------

[1] Includes small quantity of concentrates from gold and silver mills.

Mine production of metals from Arizona crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	1, 117, 914	56, 015. 58	1, 827, 097	102, 334, 542	4, 869, 470	899, 024
Coconino	22	. 46	43	5, 151		
Gila	76, 636	553. 40	111, 648	5, 667, 849	456, 128	
Graham	228	8. 50	539	1, 625	143, 617	13, 360
Greenlee	35, 385	532. 28	23, 287	5, 858, 715	1, 531	
Maricopa	353	161. 40	224	9, 064	411	
Mohave	1, 211	1, 351. 46	27, 968	8, 296	183, 353	28, 205
Pima	30, 667	241. 46	27, 258	2, 558, 227	1, 203, 835	
Pinal	65, 693	2, 175. 08	468, 430	10, 241, 714	1, 082, 121	
Santa Cruz	4, 622	110. 32	30, 838	534, 721	567, 432	
Yavapai	1, 279, 392	63, 119. 12	2, 399, 798	125, 738, 239	68, 867	141, 232
Yuma	1, 811	101. 73	2, 824	225, 092	70, 971	
	2, 613, 934	124, 370. 79	4, 919, 954	253, 183, 235	8, 647, 736	1, 081, 821
Total, 1926	2, 992, 876	137, 142. 37	5, 292, 662	287, 846, 060	14, 067, 554	11, 246, 081

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	30, 149	5, 955. 52	397, 867	171, 127	46, 531	
Copper	2, 552, 903	116, 107. 19	4, 281, 465	252, 671, 006	674	
Lead	27, 998	2, 260. 55	216, 015	304, 960	7, 798, 274	
Zinc	320	2. 40	934	6, 915	15, 113	209, 294
Copper-lead	512	30. 27	19, 723	29, 227	491, 553	
Lead-zinc	2, 052	14. 86	3, 950		295, 591	872, 527

REVIEW BY COUNTIES AND DISTRICTS

Previous issues of this annual report on metal mining in Arizona have reviewed the statistics of gold, silver, copper, lead, and zinc production and recorded significant details of mining and metallurgic activities by counties and for most of the mining districts. Long-continued shortage of personnel in the division of mineral statistics of the Bureau of Mines has so delayed the preparation of the report that the review is omitted.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By C. N. Gerry [1]

SUMMARY

The total value of the mine production of gold, silver, copper, lead, and zinc in Montana in 1927 was 17 per cent less than that in 1926, largely because of the great decrease in the output of copper and its lower average price. There were also declines in the output of gold, silver, and lead, but the output of zinc increased 9 per cent.

An exact summary of the value of the metal output of Montana by years has never been compiled, but an estimate of $1,099,019,699 was given by the Director of the Mint [2] for the gold, silver, copper, and lead produced from 1862 to 1903. Adding to this total the value of these metals and that of zinc from 1904 to 1927 gives a total of $2,614,734,520 for the State from 1862 to the end of 1927.

The total value of the mine production of gold, silver, copper, lead, and zinc in Montana for the years 1904 to 1927, as recorded in Mineral Resources of the United States, has been $1,515,714,821. Details of production are as follows: Ore, old tailings, etc., 122,408,945 short tons; gold, $73,574,865; silver, 301,540,332 fine ounces; copper, 6,058,138,346 pounds; lead, 456,353,469 pounds; and zinc, 2,322,489,345 pounds.

Silver Bow County, which includes the Butte or Summit Valley district, continued to produce most of the silver, copper, lead, and zinc and produced nearly half the gold in 1927.

Published reports show that the Anaconda Copper Mining Co., Butte & Superior Mining Co., and Galt Mining Co. paid dividends in 1927 amounting to $9,582,703, but part of the Anaconda dividend was paid from receipts from operations in other States. No complete record of Montana dividends has ever been kept, but adding the dividends of the last three years to an estimate made by one of the mining journals [3] gives a total of $364,114,604 to the end of 1927. The Anaconda, Amalgamated, North Butte, Butte & Superior, and Parrot companies have paid the larger part of this total.

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[1] The valuable assistance of B. N. Lowry and Paul Luff, of the Bureau of Mines, is acknowledged.

[2] Director of the Mint Ann. Rept. for 1904, p. 93.

[3] Mining Truth, May 16, 1925, p. 93.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold, that is, $20.671835 an ounce. The silver price for 1918 is an early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1918–1927

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1918	$1. 00	$0. 247	$0. 071	$0. 091	1923	$0. 82	$0. 147	$0. 070	$0. 068
1919	1. 12	. 186	. 053	. 073	1924	. 67	. 131	. 080	. 065
1920	1. 09	. 184	. 080	. 081	1925	. 694	. 142	. 087	. 076
1921	1. 00	. 129	. 045	. 050	1926	. 624	. 140	. 080	. 075
1922	1. 00	. 135	. 055	. 057	1927	. 567	. 131	. 063	. 064

Mine production of gold, silver, copper, lead, and zinc in Montana, 1918–1927

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1918	407	86	7, 823, 967	150, 192. 96	$3, 104, 764	16, 797, 479	$16, 797, 479
1919	395	62	4, 183, 594	107, 856. 32	2, 229, 588	12, 541, 181	14, 046, 123
1920	392	65	5. 241, 615	89, 550. 11	1, 851, 165	12, 579, 178	13, 711, 304
1921	348	97	1, 324, 801	71, 631. 91	1, 480, 763	6, 558, 713	6, 558, 713
1922	315	78	4, 385, 878	80, 145. 62	1, 656, 757	12, 468, 151	12, 468, 151
1923	304	78	5, 743, 535	85, 079. 43	1, 758, 748	13, 380, 862	10, 972, 307
1924	302	86	4, 652, 482	97, 854. 16	2, 022, 825	13, 289, 303	8, 903, 833
1925	331	93	4, 405, 008	82, 122. 85	1, 697, 630	13, 158, 191	9, 131, 784
1926	335	58	4, 470, 055	60, 504. 11	1, 250, 731	12, 769, 092	7, 967, 913
1927	247	60	4, 222, 607	53, 541. 25	1, 106, 796	11, 200, 077	6, 350, 444

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1918	323, 174, 850	$79, 824, 188	37, 135, 875	$2, 636, 647	209, 258, 148	$19, 042, 491	$121, 405, 569
1919	169, 981, 288	31, 616, 520	34, 437, 764	1, 825, 201	168, 763, 823	12, 319, 759	62, 037, 191
1920	177, 059, 260	32, 578, 904	31, 253, 916	2, 500, 313	184, 337, 786	14, 931, 361	65, 573, 047
1921	48, 098, 730	6, 204, 736	20, 366, 917	916, 511	23, 275, 966	1, 163, 798	16, 324, 521
1922	165, 754, 442	22, 376, 850	29, 767, 479	1, 637, 211	119, 069, 818	6, 786, 980	44, 925, 949
1923	224, 125, 264	32, 946, 414	35, 945, 623	2, 516, 194	141, 460, 392	9, 619, 307	57, 812, 970
1924	249, 152, 062	32. 638, 920	39, 476, 008	3, 158, 081	128, 475, 218	8, 350, 889	55, 074, 548
1925	268, 910, 847	38, 185, 340	37, 530, 644	3, 265, 166	115, 316, 922	8, 764, 086	61, 044, 006
1926	255, 372, 862	35, 752, 201	42, 306, 193	3, 384, 495	147, 401, 507	11, 055, 113	59, 410, 453
1927	223, 492, 639	29, 277, 536	35, 898, 315	2, 261, 594	160, 461, 803	10. 269, 555	49, 265, 925

Gold and silver produced at placer mines in Montana, 1918–1927

Year	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
1918	19, 167. 72	$396, 232	3, 166	$3, 166
1919	14, 097. 92	291, 430	2, 309	2, 586
1920	13, 977. 76	288, 946	2, 210	2, 409
1921	10, 988. 91	227, 161	1, 591	1, 591
1922	3, 472. 65	71, 786	652	652
1923	1, 972. 68	40, 779	360	295
1924	1, 323. 59	27, 361	187	125
1925	1, 905. 25	39, 385	405	281
1926	1, 104. 30	22, 828	162	101
1927	1, 079. 97	22, 325	197	112

GOLD

The mine production of gold in Montana in 1927, the smallest since the early years of mining, was nearly 12 per cent less than that of 1926, chiefly because the output of gold from the property of the Anaconda Copper Mining Co. at Butte, Silver Bow County, decreased and the Jardine mine in Park County was idle. The output for the State has decreased from $5,004,195 in 1915 to $1,106,796 in 1927. Silver Bow County reported nearly half the total for the State in 1927, but its output decreased 20 per cent as compared with 1926. Lewis and Clark County was second in output in 1927 and was followed in order by Madison, Broadwater, Jefferson, and Granite Counties. The largest increase in 1927 was made at the property of the Liberty Montana Mines Co. near Jefferson Island, Madison County, with the result that this property became the second largest producer of gold in Montana. Amalgamation and cyanidation mills produced 18 per cent of the total gold, yielding an average of $5.71 in gold and 49 cents in silver to the ton of ore and old tailings treated. Concentrates of all kinds yielded 66 per cent of the total gold, and crude ore shipped to smelters yielded nearly 14 per cent. Dry and siliceous ore and old tailings yielded 34 per cent of the gold; copper ore, old tailings, etc., 51 per cent; lead ore, old tailings, etc., and zinc ore, 5 per cent; lead-zinc ore, 7 per cent; and placers 2 per cent. There was a decided decrease (about 5,400 ounces) in gold from siliceous ore, especially gold ore, and a decrease of more than 1,600 ounces from lead-zinc ore.

Four properties produced 66 per cent of the total gold from Montana in 1927. The Anaconda property at Butte ranked first, followed by the property of the Liberty Montana Mines Co. near Jefferson Island, Madison County, the Drumlummon mine near Marysville, and the Jay Gould property near Wilborn, both in Lewis and Clark County. Other large producers of gold were the Butte & Superior property at Butte, Silver Bow County, the Keating property near Radersburg, Broadwater County, the Mount Washington mine near Wickes, Jefferson County, and the Emma property at Butte, Silver Bow County.

SILVER

The output of silver from mines in Montana in 1927 was also 12 per cent less than that in 1926 and was 10 per cent less than the yearly average of 12,474,223 ounces for the decade 1918 to 1927. The decrease in 1927 was due chiefly to the smaller quantity of copper ore mined at Butte. More than 55 per cent of the total silver was obtained from copper ore, old tailings, etc., 19 per cent from lead-zinc ore, 14 per cent from zinc ore, and 8 per cent from lead ore, old tailings, etc., and copper-lead ore. Silver Bow County, chiefly the Butte district, produced 86 per cent of the total. Concentrates yielded 93 per cent of the silver, first-class smelting ore 5 per cent, old tailings, slag, etc., smelted 1 per cent, and bullion from ore treated at cyanidation and amalgamation mills less than 1 per cent. The large decreases in silver from copper ore and lead-zinc ore more than offset the large increase from zinc ore.

Seven properties produced nearly 86 per cent of the total silver from Montana in 1927; each of these yielded more than 300,000 ounces and two of them—the copper mines of the Anaconda Copper Mining Co. and the Butte & Superior mine—more than 1,700,000 ounces each. The other five large producers were the Elm Orlu, Silver Dyke, Poser, Emma, and East Butte properties.

COPPER

The mine production of copper in Montana in 1927 was also 12 per cent less in quantity than in 1926. As the price of copper was slightly less than in 1926 and the demand for copper was oversupplied, no effort was made to work the mines and milling plants at maximum capacity. The total output of copper, except 2,181,104 pounds, came from Silver Bow County, which includes the Butte district. Copper ore, old tailings, etc., yielded 98 per cent of the copper. Concentrates yielded 93 per cent of the copper and crude ore of all kinds shipped to smelters 4.5 per cent; the remainder (2.5 per cent) of the copper was saved from old tailings smelted, pond slimes, slag, and precipitates. The sulphide copper ore of smelting grade yielded 9,953,959 pounds of copper, an average of 4.60 per cent, and the oxidized ore 7,172 pounds, an average of 8.15 per cent. Slag resmelted, old tailings and pond slimes smelted, and copper precipitates from mine waters yielded 5,729,959 pounds of copper.

Four properties in Montana each produced more than 3,000,000 pounds of copper in 1927. The mines of the Anaconda Copper Mining Co. yielded more than all others combined; the other three properties were the East Butte, Anselmo, and Butte & Superior. Other large producers of copper were the North Butte, Silver Dyke, and Elm Orlu properties. All the large producers of copper at Butte, except the North Butte property, decreased their output considerably.

LEAD

The mine production of lead in Montana in 1927 was 15 per cent less in quantity than in 1926 when the output was the largest ever recorded. Seventy-one per cent of the output in 1927 was derived from mines in Silver Bow County, and most of the remainder came from Cascade, Jefferson, Broadwater, Beaverhead, and Judith Basin Counties. Lead-zinc ore yielded 60 per cent of the lead, zinc ore nearly 18 per cent, lead ore, old tailings, and slag nearly 14 per cent, and copper-lead ore nearly 8 per cent. Concentrates yielded 88 per cent of the lead, crude ore of all kinds shipped to smelters 8 per cent, and old slag 4 per cent. The greater part of the lead from Montana mines, saved at East Helena, arrives at the smelter in residues from the zinc plant at Great Falls or in lead concentrate from the mill at Anaconda.

Five properties—the Emma, Butte & Superior, Poser, Elm Orlu, and Silver Dyke, each yielding more than 2,500,000 pounds—produced most of the lead. Other large producers were the Moulton, Mount Washington, Hecla slag dump, Queen of the Hills, Joe Dandy property of the Butte Copper Consolidated Mines, and Block P. mine. The Poser property was the only mine at Butte that increased its lead output.

ZINC

The mine production of zinc in Montana in 1927 was 9 per cent greater in quantity than that in 1926 and was the largest output since 1920. The zinc output from the Butte & Superior mine was 11.5 per cent more than that of 1926, and the Elm Orlu increased its output 29 per cent. The Poser, Otisco, Mount Washington, and Queen of the Hills properties also made good increases in zinc output. The mines at Butte, Silver Bow County, produced nearly 98 per cent of the total zinc from Montana in 1927, and most of the remainder came from mines in Jefferson and Cascade Counties. At Great Falls the electrolytic zinc plant of the Anaconda Copper Mining Co. was operated continuously on concentrate, chiefly from Montana, Utah, and Idaho. A few cars of zinc material were shipped to eastern smelters, but most of the lead-zinc ore was treated at the Timber Butte custom mill at Butte and the custom plant at Anaconda. The Butte & Superior Mining Co., which shipped its entire lead-zinc product to Anaconda for milling, produced approximately 41 per cent of the zinc of the State. Lead-zinc ore yielded 56 per cent of the zinc and zinc ore 44 per cent.

Eight properties at Butte—the Butte & Superior, Elm Orlu, Emma, Poser, North Butte, Moulton, Anaconda (zinc), and Otisco—produced nearly all the zinc. The first four properties, each producing more than 20,000,000 pounds of zinc, yielded 90 per cent of the State's total output.

The following tables show the relative importance of Silver Bow County or the Butte district. Cascade County was the only other county in Montana that produced metals valued at more than $900,000 in 1927.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1927, by counties

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Beaverhead	51.86	$1,072	21.33	$441	$1,513	31,943	$18,112
Broadwater	1,919.81	39,686	220.20	4,552	44,238	60,102	34,078
Cascade	372.39	7,698			7,698	702,341	398,227
Deer Lodge	659.59	13,635	9.63	199	13,834	619	351
Fergus	98.68	2,040			2,040	2,053	1,164
Granite	1,283.34	26,529	205.98	4,258	30,787	262,246	148,693
Jefferson	1,965.43	40,629	4.50	93	40,722	321,808	182,465
Judith Basin	135.16	2,794	1.60	33	2,827	34,443	19,529
Lewis and Clark	10,248.58	211,857	51.28	1,060	212,917	59,032	33,471
Lincoln	52.53	1,086			1,086	5,488	3,112
Madison	8,529.24	176,315	126.98	2,625	178,940	41,263	23,396
Meagher	.05	1	1.55	32	33	699	396
Mineral	1.79	37	55.92	1,156	1,193	10,317	5,850
Missoula			29.61	612	612		
Park	110.15	2,277	4.98	103	2,380	14	8
Phillips	119.49	2,470			2,470	74	42
Powell	625.15	12,923	316.95	6,552	19,475	8,305	4,709
Ravalli			4.45	92	92		
Sanders						188	107
Silver Bow	26,288.04	543,422	25.01	517	543,939	9,659,142	5,476,734
	52,461.28	1,084,471	1,079.97	22,325	1,106,796	11,200,077	6,350,444
Total, 1926	59,399.81	1,227,903	1,104.30	22,828	1,250,731	12,769,092	7,967,913

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	68,112	$8,923	896,513	$56,480	34,174	$2,187	$87,215
Broadwater	16,595	2,174	1,342,549	84,581	49,232	3,151	168,222
Cascade	1,605,579	210,331	4,153,356	261,661	1,275,491	81,631	959,548
Deer Lodge							14,185
Fergus							3,204
Granite	30,809	4,036	226,972	14,299	364,131	23,304	221,119
Jefferson	224,420	29,399	1,639,930	103,316	1,278,260	81,809	437,711
Judith Basin	732	96	827,246	52,116	7,227	462	75,030
Lewis and Clark	35,454	4,644	129,545	8,161	68,040	4,355	263,548
Lincoln	4,960	650	362,760	22,854	583,569	37,348	65,050
Madison	178,663	23,405	328,438	20,692			246,433
Meagher	15,148	1,984	212,152	13,366			15,779
Mineral	229	30	157,449	9,919	162,147	10,377	27,369
Missoula							612
Park							2,388
Phillips							2,512
Powell	403	53	72,949	4,596	3,247	208	29,041
Ravalli							92
Sanders			10,961	691	8,604	551	1,349
Silver Bow	221,311,535	28,991,811	25,537,495	1,608,862	156,627,681	10,024,172	46,645,518
	223,492,639	29,277,536	35,898,315	2,261,594	160,461,803	10,269,555	49,265,925
Total, 1926	255,372,862	35,752,201	42,306,193	3,384,495	147,401,507	11,055,113	59,410,453

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Montana, 1926–27, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1926	1927	1926	1927	1926	1927
Beaverhead	20,487	9,249	19	12	$1.61	$2.07
Broadwater	17,777	12,978	27	18	4.45	5.68
Cascade	251,891	279,544	13	8	2.05	1.45
Deer Lodge	125	795	5	4	23.43	17.59
Fergus	126	60	3	3	37.92	53.40
Granite	11,445	57,615	25	18	10.27	3.04
Jefferson	66,729	40,941	54	36	4.55	5.45
Judith Basin	28,275	3,559	5	5	3.42	6.27
Lewis and Clark	36,453	34,862	38	25	6.82	7.04
Lincoln	6,536	5,002	2	3	.97	.84
Madison	5,492	22,240	62	51	11.38	8.98
Meagher	2,870	1,412	6	3	.45	.28
Mineral	10,291	471	7	3	1.50	12.50
Missoula	419		2		8.57	
Park	24,631	40	2	1	4.54	57.10
Phillips	6	31	2	2	127.50	81.03
Powell	430	517	11	11	19.70	34.05
Ravalli	239		2		9.37	
Sanders	248	45	6	1	4.12	2.38
Silver Bow	3,985,585	3,753,246	44	43	1.90	1.60
	4,470,055	4,222,607	335	247	2.06	1.76

Production of placer mines in Montana in 1927, by counties

County	Mines		Gold	Silver (fine ounces)	Total value
	Drift	Hydraulic and sluicing			
Beaverhead		4	$441	2	$442
Broadwater		7	4,552	43	4,576
Deer Lodge		1	199		199
Granite		8	4,258	59	4,291
Jefferson		1	93	1	94
Judith Basin		1	33		33
Lewis and Clark	2	6	1,060	6	1,063
Madison	1	5	2,625	18	2,635
Meagher	1		32		32
Mineral	1	2	1,156		1,156
Missoula		4	612		612
Park		1	103	1	104
Powell	1	11	6,552	52	6,582
Ravalli		1	92		92
Silver Bow		2	517	15	526
	6	54	22,325	197	22,437
Total, 1926	2	56	22,828	162	22,929

MINING INDUSTRY

The general decrease in the metal output of Montana in 1927 was the natural result of the drop in the average prices of silver, copper, lead, and zinc. The State still retained a prominent place as a producer of copper, silver, and zinc. In general, mining conditions were fair, but there was no incentive to increase the output. However, much progress was made in the development at depth of the mines of Butte and in the installation of hoists to aid deeper mining. Progress in the treatment of lead-zinc ore in Montana has been so rapid that it was found necessary not only to increase the capacity of the electrolytic zinc plant at Great Falls but to construct a new plant at Anaconda. An interesting feature of the year was the construction of a plant at East Helena to treat slag containing zinc.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Montana, 1918–1927, with content in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
DRY AND SILICEOUS ORE						
1918	286,522	80,613.50	1,028,443	251,764	33,264	----
1919	221,686	64,289.55	1,707,053	396,501	140,694	----
1920	178,352	45,293.42	2,000,162	358,808	611,004	----
1921	164,906	47,377.95	1,546,910	85,468	956,655	----
1922	373,311	53,343.24	2,197,802	217,906	581,205	----
1923	342,253	54,743.81	1,280,235	50,271	42,867	----
1924	207,487	63,174.26	947,083	309,015	627,015	----
1925	194,691	38,081.43	591,369	157,745	368,128	----
1926	93,571	23,810.07	345,456	55,266	72,924	----
1927	111,976	18,389.30	427,105	22,865	93,674	----
COPPER ORE						
1918	6,412,941	32,464.51	10,521,219	[1] 316,740,920	----	----
1919	3,081,451	16,612.99	6,341,825	[1] 165,321,847	----	----
1920	4,002,491	18,720.88	6,030,507	[1] 172,581,159	1,847	----
1921	928,461	4,733.30	1,663,472	[1] 46,888,812	1,029	----
1922	3,250,213	13,367.13	5,446,684	[1] 162,860,743	----	----
1923	4,420,601	19,776.67	7,619,864	[1] 220,471,500	1,864	----
1924	3,437,931	24,926.12	7,845,180	[1] 243,927,687	----	----
1925	3,190,841	32,352.64	8,656,401	[1] 265,201,209	----	----
1926	3,179,051	27,289.67	7,762,190	[1] 250,247,871	----	----
1927	2,958,445	27,241.47	6,201,827	[1] 218,647,748	1,630	----
LEAD ORE						
1918	31,423	4,747.38	707,757	178,809	6,537,297	----
1919	33,551	3,797.15	747,960	192,927	6,753,703	----
1920	64,563	3,084.34	800,856	199,951	9,583,916	----
1921	113,481	4,151.98	1,352,125	215,114	7,414,293	11,167
1922	96,203	2,783.02	647,754	33,275	8,133,697	----
1923	105,450	2,368.15	437,703	184,842	8,741,531	69,560
1924	78,656	1,486.37	287,041	222,066	7,829,188	----
1925	118,062	2,393.79	532,219	387,701	9,320,422	----
1926	132,039	2,391.32	514,628	363,825	8,467,354	----
1927	57,182	1,540.90	314,100	196,402	4,912,945	----
COPPER-LEAD ORE						
1918	253	32.02	2,304	10,086	81,775	----
1919	971	90.08	58,335	86,416	480,662	----
1920	1,787	113.83	38,685	62,508	375,072	----
1921	334	10.59	26,244	24,388	166,526	----
1922	21,251	659.18	122,153	204,497	518,697	----
1923	106,325	271.05	340,559	598,152	1,445,059	----
1924	160,883	332.74	573,038	1,181,998	2,339,877	----
1925	195,327	2,113.50	555,365	1,382,541	2,576,816	----
1926	224,322	331.43	668,986	1,650,177	3,910,331	----
1927	263,868	314.92	559,918	1,573,206	2,812,096	----
ZINC ORE, LEAD-ZINC ORE, AND COPPER-LEAD-ZINC ORE						
1918	1,092,828	13,167.83	4,534,590	5,993,271	30,483,539	209,258,148
1919	845,935	8,968.63	3,683,699	3,983,597	27,062,705	168,763,823
1920	994,422	8,359.88	3,706,758	3,856,834	20,682,077	184,337,786
1921	117,619	4,369.18	1,968,371	884,948	11,828,414	23,264,799
1922	644,900	6,520.40	4,053,106	2,438,021	20,533,880	119,069,818
1923	768,906	5,947.07	3,702,141	2,820,499	25,714,302	141,390,832
1924	767,525	6,611.08	3,636,774	3,511,296	28,679,928	128,475,218
1925	706,087	5,276.24	2,822,432	1,781,651	25,265,278	115,316,922
1926	841,072	5,577.32	3,477,670	3,055,723	29,855,584	147,401,507
1927	831,136	4,974.69	3,696,930	3,052,418	28,077,970	160,461,803

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[1] Includes copper recovered from precipitates.

Ore, old tailings, etc., sold or treated in Montana in 1927, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.		Gold		Silver	
		Short tons	Per cent	Fine ounces	Per cent	Fine ounces	Per cent
Dry gold ore	79	[1] 50, 764	1. 20	16, 467. 40	30. 75	56, 756	0. 51
Dry gold and silver ore	5	170		138. 94	. 26	5, 574	. 05
Dry silver ore	37	[2] 61, 042	1. 45	1, 782. 96	3. 33	364, 775	3. 26
Copper ore	29	[3] 2, 958, 445	70. 06	27, 241. 47	50. 88	6, 201, 827	55. 37
Lead ore	80	[4] 57, 182	1. 36	1, 540. 90	2. 88	314, 100	2. 80
Zinc ore	5	332, 404	7. 87	1, 208. 51	2. 26	1, 607, 188	14. 35
Copper-lead ore	1	263, 868	6. 25	314. 92	. 59	559, 918	5. 00
Lead-zinc ore	39	498, 732	11. 81	3, 766. 18	7. 03	2, 089, 742	18. 66
Total, lode mines	[5] 247	4, 222, 607	100. 00	52, 461. 28	97. 98	11, 199, 880	100. 00
Total, placers	60			1, 079. 97	2. 02	197	
	307	4, 222, 607	100. 00	53, 541. 25	100. 00	11, 200, 077	100. 00
Total, 1926	393	4, 470, 055		60, 504. 11		12, 769, 092	

Source	Copper		Lead		Zinc	
	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent
Dry gold ore	3, 157		19, 539	0. 06		
Dry gold and silver ore	81		6, 074	. 02		
Dry silver ore	19, 627	0. 01	68, 061	. 19		
Copper ore	[6] 218, 647, 748	97. 83	1, 630			
Lead ore	196, 402	. 09	4, 912, 945	13. 69		
Zinc ore	1, 011, 623	. 45	6, 365, 865	17. 73	70, 251, 405	43. 78
Copper-lead ore	1, 573, 206	. 71	2, 812, 096	7. 83		
Lead-zinc ore	2, 040, 795	. 91	21, 712, 105	60. 48	90, 210, 398	56. 22
	[6] 223, 492, 639	100. 00	35, 898, 315	100. 00	160, 461, 803	100. 00
Total, 1926	[7] 255, 372, 862		42, 306, 193		147, 401, 507	

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[1] Includes 1,063 tons of old tailings cyanided.

[2] Includes 53,196 tons of old tailings concentrated and 532 tons of old tailings sold to a smelter.

[3] Includes 27,191 tons of old tailings sold to a smelter, 579 tons of old tailings concentrated, and 1,697 tons of pond slimes.

[4] Includes 19,641 tons of old slag sold to a smelter and 28,000 tons of old tailings concentrated.

[5] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

[6] Includes 4,515,407 pounds of copper recovered from precipitates.

[7] Includes 5,044,108 pounds of copper recovered from precipitates.

Value of metals from ore, old tailings, etc., sold or treated in Montana in 1927, by kinds of ore

Kind of ore	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	50, 764	$340, 412	$32, 181	$413	$1, 231		$374, 237
Dry gold and silver ore	170	2, 872	3, 160	11	383		6, 426
Dry silver ore	61, 042	36, 857	206, 827	2, 571	4, 288		250, 543
Copper ore	2, 958, 445	563, 131	3, 516, 436	[1] 28, 642, 855	103		32, 722, 525
Lead ore	57, 182	31, 853	178, 095	25, 729	309, 515		545, 192
Zinc ore	332, 404	24, 982	911, 276	132, 523	401, 049	$4,496,090	5, 965, 920
Copper-lead ore	263, 868	6, 510	317, 473	206, 090	177, 162		707, 235
Lead-zinc ore	498, 732	77, 854	1, 184, 884	267, 344	1, 367, 863	5, 773, 465	8, 671, 410
	4, 222, 607	1, 084, 471	6, 350, 332	[1] 29, 277, 536	2, 261, 594	10,269,555	49, 243, 488
Total, 1926	4, 470, 055	1, 227, 903	7, 967, 812	[2] 35, 752, 201	3, 384, 495	11,055,113	59, 387, 524

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[1] Includes value of 4,515,407 pounds of copper recovered from precipitates.

[2] Includes value of 5,044,108 pounds of copper recovered from precipitates.

GOLD ORE

Gold ore and old tailings, largely dry and siliceous, were reported from 79 mines in Montana in 1927, compared with 101 in 1926. This material, the output of which decreased 37 per cent, yielded on the average $6.71 in gold and 1.12 ounces of silver to the ton and a little copper and lead and was valued at $7.37 in recovered metals a ton. Lewis and Clark, Broadwater, and Madison Counties, in the order named, produced most of the gold ore; the Drumlummon mine at Marysville, Lewis and Clark County, was the largest producer, with the Jay Gould property at Wilborn, also in Lewis and Clark County, following.

GOLD AND SILVER ORE

Gold and silver ore was reported from five mines in four counties in Montana in 1927. This ore yielded on the average $16.89 in gold and 32.79 ounces of silver to the ton, 0.024 per cent of copper, and 1.786 per cent of lead. Most of the output was smelting ore from the Blue Eyed Maggie mine at Deer Lodge, Powell County, and from the Bullion property near Basin, Jefferson County.

SILVER ORE

A total of 37 mines made the output of siliceous silver ore and old tailings in Montana in 1927, which yielded on the average 60 cents in gold and 5.98 ounces of silver to the ton, 0.016 per cent of copper, and 0.056 per cent of lead. The output of this class of material showed a marked gain, as a result of the large increase in the treatment of old silver tailings from the Granite Bimetallic dump at Philipsburg, in Granite County. Some of the other large producers of silver ore or old tailings in 1927 were the Agnes-Highland and Eveline properties at Butte, Silver Bow County, and the Hoffman property near Maxville, Granite County.

COPPER ORE

Copper ore, old tailings, etc., the output of which decreased 7 per cent compared with 1926, were reported from 29 mines in Montana in 1927 and represented 70 per cent of the State total. The average yield of the ore, etc., was 19 cents in gold and 2.10 ounces of silver to the ton and 3.62 per cent of copper, or 72.38 pounds to the ton; the average value in recovered metals a ton was $10.86, exclusive of the value of copper from mine-water precipitates. Nearly all the copper ore was mined at Butte—largely from the Anaconda, East Butte, Anselmo, Butte & Superior, North Butte, and Elm Orlu properties—and most of it was milling ore. The Liberty Montana Mines Co., operating the Mammoth property near Jefferson Island, Madison County, became the fifth largest producer of copper ore in Montana in 1927.

LEAD ORE

The output of lead ore, old tailings, and slag, reported from 80 mines in Montana in 1927, decreased nearly 57 per cent from that in 1926 and yielded metals valued at $545,192, or an average of $9.53 in recovered metals a ton. The average yield was 56 cents in gold and 5.49 ounces of silver to the ton, 0.17 per cent of copper, and 4.296 per cent of lead. About half the lead material was old tailings concentrated from the Alta dump near Corbin, Jefferson County. Other large producers of lead ore, old tailings, etc., were the Gibson slag dump near Giant Springs, Cascade County, the Hecla slag dump near Melrose, Beaverhead County, and the Block P. property near Monarch, Judith Basin County.

COPPER-LEAD ORE

Copper-lead ore of milling grade was mined chiefly at the Silver Dyke property at Neihart.

ZINC ORE

Zinc ore, all of which was milled, was produced by five mines at Butte in 1927. The average yield of the ore was 8 cents in gold and 4.84 ounces of silver to the ton, 0.15 per cent of copper, 0.96 per cent of lead, and 10.57 per cent of zinc, and the average value in recovered metals a ton was $17.95. Most of the zinc ore was produced from the Black Rock property of the Butte & Superior Mining Co. Other large producers were the North Butte and Anselmo mines.

LEAD-ZINC ORE

The output of lead-zinc ore in Montana in 1927 was reported from 39 mines and represented nearly 12 per cent of the total, but it was 39 per cent less than that in 1926. The average yield was 16 cents in gold and 4.19 ounces of silver to the ton, 0.20 per cent of copper, 2.18 per cent of lead, and 9.044 per cent of zinc. The average value in recovered metals a ton was $17.39. Three mines at Butte—the Elm Orlu, Emma, and Poser—produced more than 84 per cent of the lead-zinc ore; all of it was milled at Butte or Anaconda. The next largest producers were the Moulton and Anaconda properties, also at Butte. Large shipments of lead-zinc ore for custom milling were made from the Mount Washington mine, near Wickes, Jefferson County, and from the Queen of the Hills property, near Neihart, Cascade County.

Ore, old tailings, etc., sold or treated in Montana in 1927, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	59	10.60	35	69	275	
Broadwater	10,155	1,347.59	256			
Deer Lodge	789	658.24	127			
Fergus	18	96.01	91			
Granite	347	192.66	221			
Jefferson	1,660	470.48	713	1,839	3,387	
Lewis and Clark	[1] 34,389	10,191.85	51,047	827	10,647	
Madison	3,080	2,637.30	3,550	170	1,530	
Park	40	110.11	13			
Phillips	31	119.51	74			
Powell	138	493.21	444		3,700	
Silver Bow	58	139.84	185	252		
	50,764	16,467.40	56,756	3,157	19,539	
Total, 1926	80,847	21,583.35	75,148	5,653	37,740	

[1] Includes 1,063 tons of old tailings cyanided.

Ore, old tailings, etc., sold or treated in Montana in 1927, by counties, with content in terms of recovered metals—Continued

DRY GOLD AND SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Jefferson	69	37. 10	1, 281			
Lewis and Clark	3	. 20	6	81		
Madison	21	12. 80	523		1, 022	
Powell	77	88. 84	3, 764		5, 052	
	170	138. 94	5, 574	81	6, 074	
Total, 1926	1, 415	482. 70	16, 389	34, 919	5, 640	

DRY SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaverhead	13	0. 39	2, 396	198		
Cascade	70	. 70	1, 960		6, 025	
Deer Lodge	6	1. 38	492			
Fergus	42	2. 68	1, 962			
Granite	[2] 55, 037	1, 030. 56	211, 320	14, 547	59, 471	
Jefferson	[3] 640	43. 63	12, 496	2, 060	679	
Lewis and Clark	24	9. 40	2, 131	588	1, 531	
Madison	143	13. 87	10, 701		355	
Silver Bow	5, 067	680. 35	121, 317	2, 234		
	61, 042	1, 782. 96	364, 775	19, 627	68, 061	
Total, 1926	11, 309	1, 744. 02	253, 919	14, 694	29, 544	

COPPER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaverhead	49	0. 33	48	11, 281	1, 630	
Broadwater	14	8. 51	36	1, 315		
Granite	154	1. 02	387	15, 096		
Jefferson	17	3. 09	375	3, 454		
Lewis and Clark	80	. 08	227	27, 625		
Madison	18, 468	5, 775. 99	13, 884	177, 142		
Meagher	38	. 05	8	15, 148		
Silver Bow	[4] 2, 939, 625	21, 452. 40	6, 186, 862	[5] 218, 396, 687		
	2, 958, 445	27, 241. 47	6, 201, 827	[5] 218, 647, 748	1, 630	
Total, 1926	3, 179, 051	27, 289. 67	7, 762, 190	[6] 250, 247, 871		

LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaverhead	[7] 9, 001	38. 21	28, 660	55, 566	856, 292	
Broadwater	2, 698	561. 70	58, 925	15, 280	1, 321, 089	
Cascade	[8] 9, 690	2. 23	31, 033	31, 178	453, 337	
Granite	213	30. 10	9, 914	390	83, 351	
Jefferson	[9] 29, 578	611. 37	125, 031	86, 687	603, 118	
Judith Basin	3, 516	134. 20	33, 866	732	820, 033	
Lewis and Clark	167	24. 00	3, 920	4, 586	76, 849	
Lincoln	2	5. 93	6		206	
Madison	528	89. 26	12, 587	1, 351	325, 531	
Meagher	[10] 1, 374		691		212, 152	
Mineral	132	1. 40	5, 685	229	102, 619	
Powell	283	42. 50	3, 782	403	58, 368	
	57, 182	1, 540. 90	314, 100	196, 402	4, 912, 945	
Total, 1926	132, 039	2, 391. 32	514, 628	363, 825	8, 467, 354	

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[2] Includes 53,196 tons of old tailings concentrated.

[3] Includes 532 tons of old tailings sold to a smelter.

[4] Includes 27,191 tons of old tailings sold to a smelter, 579 tons of old tailings concentrated, and 1,697 tons of pond slimes.

[5] Includes 4,515,407 pounds of copper recovered from precipitates.

[6] Includes 5,044,108 pounds of copper recovered from precipitates.

[7] Includes 8,624 tons of slag sold to a smelter.

[8] Includes 9,643 tons of slag sold to a smelter.

[9] Includes 28,000 tons of old tailings concentrated.

[10] Old slag sold to a smelter.

Ore, old tailings, etc., sold or treated in Montana in 1927, by counties, with content in terms of recovered metals—Continued

LEAD-ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	127	2.33	802	998	38,316	34,174
Broadwater	111	2.03	842		21,460	49,232
Cascade	5,916	54.53	109,430	1,195	881,898	1,275,491
Granite	1,864	28.98	40,345	776	84,150	364,131
Jefferson	8,977	799.78	181,911	130,380	1,032,746	1,278,260
Judith Basin	43	.94	577		7,213	7,227
Lewis and Clark	199	23.02	1,695	1,747	40,518	68,040
Lincoln	5,000	46.60	5,482	4,960	362,554	583,569
Mineral	339	.40	4,632		54,830	162,147
Powell	19	.62	263		5,829	3,247
Sanders	45		188		10,961	8,604
Silver Bow	476,092	2,806.95	1,743,575	1,900,739	19,171,630	86,376,276
	498,732	3,766.18	2,089,742	2,040,795	21,712,105	90,210,398
Total, 1926	820,081	5,415.40	3,354,233	2,706,528	29,610,186	142,936,776

Zinc and lead-zinc concentrates (as marketed from Montana mines and mills) sold to smelters in 1927

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Zinc concentrates	Beaverhead, Broadwater, Granite, Jefferson, Lewis and Clark, Lincoln, Mineral, and Silver Bow.	155,138	180,172,480	58.07	155,925,325
Lead-zinc concentrates.	Cascade, Granite, Jefferson, Judith Basin, Lewis and Clark, Powell, Sanders, and Silver Bow.	5,068	5,302,356	52.31	4,536,478
		160,206	185,474,836	57.89	160,461,803

METALLURGIC INDUSTRY

The principal methods of working Montana ores are concentrating, direct smelting, and leaching. The value of metals recovered from first-class smelting ore and ore and old tailings treated in gold and silver mills in 1927 was only 4 per cent of the value of the State output.

Thirty-three milling plants of various kinds were active in Montana in 1927, although many of them ran for short periods only. They include 7 plants using the amalgamation process, 3 using amalgamation and concentration, 2 using cyanidation, 2 using amalgamation, concentration, and cyanidation, 7 using table concentration, 4 using flotation equipment after table concentration, and 5 using straight flotation. Two copper-precipitating plants at Butte that recover copper from mine waters and one electrolytic zinc-leaching plant are also included in the total.

Of the ore and old tailings treated at gold and silver mills, 13,269 tons of ore were treated by amalgamation, with an average recovery per ton of $6.18 in gold and 0.19 ounce of silver, and 20,667 tons of ore and 1,063 tons of old tailings were treated by cyanidation, with an average recovery per ton of $5.43 in gold and 1.28 ounces of silver. During the year 295 pounds of quicksilver were purchased—0.022 pound per ton of ore amalgamated and 0.046 pound per ounce of gold and silver bullion recovered—and 36,308 pounds of sodium cyanide were used in gold and silver mills—1.081 pounds per ounce of gold and silver bullion and 1.67 pounds per ton of ore and old tailings treated. The quantity of ore and old tailings treated by these processes in 1927 decreased 45 per cent from 1926, chiefly because the Jardine mill has remained closed since May, 1926. The quantity of gold recovered by cyanidation increased 4 per cent, and that recovered by amalgamation decreased nearly 45 per cent.

Concentrating mills in Montana treated 95 per cent of the total material mined or treated. The resulting concentrates, together with those from gold and silver mills, averaged $50.57 in recovered metals a ton compared with $40.95 in 1926, although the quantity of concentrates produced was 32 per cent less than in 1926. The decrease in quantity was especially marked in copper concentrate and in lead-zinc concentrate; the increase in zinc concentrate was notable. The copper concentrate, which exceeded all others in total value of metals recovered, was the least valuable per ton.

Crude ore directly smelted in 1927 averaged $15.94 in recovered metals a ton; the total quantity decreased 21 per cent. This decrease was largely in copper ore which was the chief product smelted and was of comparatively little value per ton. An increase was shown in the quantity of siliceous ore smelted.

The miscellaneous material, other than ore and old tailings milled and crude ore smelted, consisted of 49,061 tons of slag, old tailings, and pond slimes shipped for smelting and mine-water precipitates. It yielded 269.81 ounces of gold, 94,203 ounces of silver, 5,729,959 pounds of copper, and 1,370,420 pounds of lead and came chiefly from Silver Bow, Beaverhead, and Cascade Counties.

Mine production of metals from gold and silver mills in Montana in 1927, by counties

County	Ore and old tailings treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Broadwater	12	----------	42.99	9	----------	----------
Jefferson	21	----------	31.18	16	----------	----------
Lewis and Clark	32,021	1,063	3,142.51	2,171	5,385.58	26,584
Madison	1,798	----------	671.28	257	298.50	1,245
Phillips	30	----------	----------	----------	21.71	55
Powell	54	----------	80.18	35	----------	----------
	33,936	1,063	3,968.14	2,488	5,705.79	27,884
Total, 1926	59,860	3,540	7,169.84	3,265	5,479.32	61,534

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Lewis and Clark	279	707.80	19,044	488	----------
Madison	11	39.14	149	92	1,381
Powell	2	309.45	108	----------	----------
	292	1,056.39	19,301	580	1,381
Total, 1926	808	2,960.80	32,802	283	14,520

Mine production of metals from concentrating mills in Montana in 1927, by counties

County	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	127	--------	66	2. 33	802	998	38, 316	34, 174
Broadwater	11, 011	--------	2, 167	1, 177. 73	7, 286	1, 180	87, 580	49, 232
Cascade	269, 784	--------	14, 352	369. 46	669, 348	1, 574, 401	3, 693, 994	1, 275, 491
Granite	3, 364	53, 196	2, 178	1, 066. 03	224, 088	14, 825	138, 709	364, 131
Jefferson	8, 977	28, 000	3, 776	1, 142. 38	251, 955	185, 195	1, 294, 664	1, 278, 260
Judith Basin	3, 114	--------	1, 064	50. 84	22, 974	--------	487, 184	7, 227
Lewis and Clark	229	--------	109	30. 12	1, 760	1, 965	49, 781	68, 040
Lincoln	5, 000	--------	997	46. 60	5, 482	4, 960	362, 554	583, 569
Madison	19, 449	--------	1, 194	6, 171. 79	14, 472	172, 286	--------	--------
Mineral	339	--------	206	. 40	4, 632	--------	54, 830	162, 147
Park	40	--------	2	110. 11	13	--------	--------	--------
Powell	183	--------	49	6. 22	677	--------	14, 624	3, 247
Sanders	45	--------	19	--------	188	--------	10, 961	8, 604
Silver Bow	3, 610, 669	579	886, 069	24, 015. 97	9, 243, 605	205, 774, 687	25, 537, 495	156, 627, 681
	3, 932, 331	81, 775	912, 248	34, 189. 98	10, 447, 282	207, 730, 497	31, 770, 692	160, 461, 803
Total, 1926	3, 795, 435	363, 548	1, 340, 722	34, 845. 34	11, 754, 912	234, 377, 613	36, 751, 351	147, 282, 661

Mine production of metals from Montana concentrates in 1927

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	66	2. 33	802	998	38, 316	34, 174
Broadwater	2, 167	1, 177. 73	7, 286	1, 180	87, 580	49, 232
Cascade	14, 352	369. 46	669, 348	1, 574, 401	3, 693, 994	1, 275, 491
Granite	2, 178	1, 066. 03	224, 088	14, 825	138, 709	364, 131
Jefferson	3, 776	1, 142. 38	251, 955	185, 195	1, 294, 664	1, 278, 260
Judith Basin	1, 064	50. 84	22, 974	--------	487, 184	7, 227
Lewis and Clark	388	737. 92	20, 804	2, 453	49, 781	68, 040
Lincoln	997	46. 60	5, 482	4, 960	362, 554	583, 569
Madison	1, 205	6, 210. 93	14, 621	172, 378	1, 381	--------
Mineral	206	. 40	4, 632	--------	54, 830	162, 147
Park	2	110. 11	13	--------	--------	--------
Powell	51	315. 67	785	--------	14, 624	3, 247
Sanders	19	--------	188	--------	10, 961	8, 604
Silver Bow	886, 069	24, 015. 97	9, 243, 605	205, 774, 687	25, 537, 495	156, 627, 681
	912, 540	35, 246. 37	10, 466, 583	207, 731, 077	31, 772, 073	160, 461, 803
Total, 1926	1, 341, 530	37, 806. 14	11, 787, 714	234, 377, 896	36, 765, 871	147, 282, 661

BY KINDS OF CONCENTRATES

Dry and siliceous	4, 201	3, 736. 48	203, 801	14, 537	54, 559	--------
Copper	718, 203	25, 840. 64	5, 978, 644	203, 474, 950	--------	--------
Lead	19, 994	1, 678. 08	1, 304, 153	1, 136, 179	19, 498, 725	--------
Zinc	155, 138	3, 051. 07	2, 300, 948	1, 715, 732	8, 742, 398	155, 925, 325
Copper-lead	9, 936	243. 78	487, 899	1, 132, 867	2, 812, 096	--------
Lead-zinc	5, 068	696. 32	191, 138	256, 812	664, 295	4, 536, 478

Mine production of metals from Montana crude ore shipped to smelters in 1927

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	498	49.53	18,797	20,193	121,857	
Broadwater	1,955	699.11	52,764	15,415	1,254,969	
Cascade	117	1.50	4,859	146	37,434	
Deer Lodge	795	659.62	619			
Fergus	60	98.69	2,053			
Granite	1,055	217.29	38,099	15,984	88,263	
Jefferson	3,411	773.72	60,446	39,225	345,266	
Judith Basin	445	84.30	11,469	732	340.062	
Lewis and Clark	1,549	982.54	9,467	33,001	79,764	
Lincoln	2	5.93	6		206	
Madison	993	1,348.51	25,122	6,285	327,057	
Meagher	38	.05	8	15,148		
Mineral	132	1.40	5,685	229	102,619	
Phillips	1	97.80	19			
Powell	280	229.32	7,433	403	58,325	
Silver Bow	113,110	2,021.86	371,876	9,884,842		
	124,441	7,271.17	608,722	10,031,603	2,755,822	
Total, 1926	157,579	8,471.09	712,481	13,753,796	2,872,503	118,846

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	10,704	4,927.92	183,393	8,236	37,734	
Copper	108,361	1,221.78	251,556	9,961,131	1,630	
Lead	5,376	1,121.47	173,773	62,236	2,716,458	

REVIEW BY COUNTIES AND DISTRICTS

BEAVERHEAD COUNTY

The value of the mine production of metals in Beaverhead County decreased from $198,585 in 1926 to $87,215 in 1927. Most of the returns came from old slag shipped from the Hecla dump, and the largest decrease was in the output of lead from this dump. The large mill of the Boston-Montana Mining Corporation west of Divide was idle throughout the year.

Argenta district.—Two placers and nine lode mines in the Argenta district produced 356 tons of ore, $739 in gold, 1,551 ounces of silver, 13,010 pounds of copper, 99,839 pounds of lead, and 34,174 pounds of zinc, valued in all at $11,799; the ore yielded on the average $32.15 in metals a ton. The Ferdinand property near Argenta was worked by a lessee, and four cars of lead-zinc ore were shipped to flotation plants for custom milling. Small lots of oxidized lead ore were shipped from the Anaconda, Iron Mountain, Brownell, and Mauldin claims. The Iron Mountain or Butte-Argenta property, the most important producer in the district in 1926, was practically idle in 1927. One car of copper ore was shipped from the Goldsmith claim by lessees and another car from the Tuscarora property of the Great Western Development Co. The product from the district was shipped by way of Dillon on the Oregon Short Line Railroad to smelting plants at East Helena and Anaconda, Mont., and to smelters and mills in Utah. A little gold was recovered from rich placers by sluicing operations at the Pilgrim and other claims on French Creek, 9 miles west of Argenta.

Bald Mountain district.—A small lot of placer gold was recovered at the Double Eagle claim, but production was curtailed by lack o capital.

Bannack district.—The Royal Dutch Metals (Inc.) made arrangements to place a large group of claims at Bannack on a producing basis. The Golden Leaf, one of 16 claims and a former producer, is equipped with a 300-ton cyanidation plant. Much development has been done in the past, and considerable $12 gold ore is said to be developed. A short article[4] giving the ore occurrence and the association of the gold with tellurides and pyrite was published in February.

Beaverhead district.—The Little Nugget placer on May Creek, 22 miles from Wisdom, was worked a short time in the summer, and a little gold was recovered by sluicing.

Blue Wing district.—A small lot of unusually rich silver ore of smelting grade was shipped from the New Departure claim.

Bryant district (*Melrose*).—The Cleve and Avon claims of the Hecla Consolidated Mining Co., large producers of lead ore in the past, were operated under lease by the United States Smelting, Refining, Mining & Exploration Co. Several cars of oxidized lead ore containing considerable silver were shipped to Midvale, Utah, for smelting. The property is 16 miles from Melrose on the Oregon Short Line Railroad. Several thousand tons of old slag containing lead and a little silver and copper was shipped from the old slag dump of the Hecla property to the smelter at East Helena.

BROADWATER COUNTY

The value of the mine production of metals in Broadwater County increased from $151,670 in 1926 to $168,222 in 1927, as a result of the large quantity of iron-gold ore milled from the Keating mine, the large quantity of lead ore milled from the Little Olga & Quartette group of claims, and the increased shipments of lead-silver ore from the East Pacific and Joe Dandy properties. Intensive work was done at the East Pacific mine, which was acquired by the Montana-Idaho Mines Corporation.

Backer district (*Canton*).—Four placers and one lode mine in the Backer district produced 10 tons of ore, $4,784 in gold, and 47 ounces of silver, valued together at $4,811. As in the past, a little rich gold ore was mined from narrow seams in the Slim Jim property and was treated by amalgamation. Placer gold was recovered at the Eldorado Bar, Cement Gulch, York, and Robison claims in Confederate Gulch. Most of the output was recovered from the Eldorado Bar or Confederate placer near Townsend.

Beaver district (*Winston*).—Four lode mines in the Beaver district produced 1,672 tons of ore, yielding $11,076 in gold, 45,838 ounces of silver, 15,266 pounds of copper, and 574,148 pounds of lead, valued in all at $75,237, or $45 in metals a ton. The output consisted of 772 tons of ore of smelting grade and of 900 tons of milling ore which was reduced to 87 tons of concentrates. The increase of $49,077 in the value of the output was due to the shipments of ore from the East Pacific and Little Olga & Quartette properties. First-class silver-lead ore containing considerable gold was shipped from the East Pacific property to the smelter at East Helena, by way of Winston. The East Pacific mine was worked by the Montana-Idaho Mines Corporation, and 700 feet of development was done in drifting and raising. The company also operated the Little Olga & Quartette (Kleinschmidt) property and treated several hundred tons of lead ore in a 15-ton pilot flotation mill. Four cars of first-class lead ore were also shipped from the property, which was worked experimentally five months. Small lots of lead ore containing considerable gold and silver were shipped from the Sunshine and Satellite claims.

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[4] Shenon, P. J., Gold at Bannack, Mont.: Eng. and Min. Jour., vol. 123, Feb. 19, 1927, p. 326.

Cedar Plains district (*Radersburg*).—One placer and seven lode mines in the Cedar Plains district produced 11,161 tons of ore, $27,652 in gold, 13,035 ounces of silver, and 745,134 pounds of lead, valued in all at $81,987; the ore had an average value of $7.33 in metals a ton. The Joe Dandy group, 15 miles southwest of Toston, was worked intensively by the Butte Copper Consolidated Mines. The company shipped more than 700 tons of silver-lead ore from the old workings; development consisted of sinking the vertical shaft an additional 250 feet. Work at the Keating mine was suspended in the spring, but considerable iron ore containing gold was concentrated and about 2,000 tons of gold-iron concentrate was shipped to East Helena for smelting. Several cars of high-grade silver-lead ore were shipped from the Santa Anita property. The Ohio Keating mine was not worked regularly, but three cars of iron ore containing gold were produced. Small lots of lead ore were shipped from the Summit and North Home properties, and one car of gold ore from the Black Friday claim.

Park (*Hassel*) *district* (*Townsend*).—Two placers and six lode mines in the Park district produced 135 tons of ore, $726 in gold, 1,182 ounces of silver, 1,329 pounds of copper, 23,267 pounds of lead, and 49,232 pounds of zinc, valued in all at $6,187; the ore had an average value of $43.06 in metals a ton. The Iron Mask mine, 8 miles west of Townsend, was worked a short time by the Creden Corporation, and four cars of lead-zinc ore were shipped to Butte for custom milling. Small lots of lead ore were shipped from the Silver Wave, Little Fannie, and Bird properties. A small lot of copper ore was marketed from the Moonbeam claim, and a test sample of gold ore from the Little Giant property was treated by amalgamation. A little placer gold was recovered by sluicing operations on Indian Creek.

CASCADE COUNTY

The value of the mine production of metals in Cascade County in 1927 was $959,548, more than double that of any other county except Silver Bow, which includes the Butte district. The decrease of $250,222 from the value for the county in 1926 was due chiefly to the decrease in the output of silver and lead from the Silver Dyke property near Neihart and in the shipments of slag from the old smelter site near Gibson below Great Falls. The output of zinc, the only metal to show an increase, was nearly double that of 1926.

The Anaconda Copper Mining Co. operated its roasting, leaching, refining, and manufacturing plants at Black Eagle near Great Falls. The electrolytic zinc plant treated zinc ore and concentrate from Montana, Idaho, Utah, Washington, and Nevada and made slab zinc at the rate of about 18,761,000 pounds a month. The installation of a secondary purification plant at the electrolytic zinc plant and other construction work at Great Falls cost $385,165. As the Great Falls zinc plant was not able to handle the increased quantity of zinc concentrate coming from the mills in Utah, the company erected, at Anaconda, an electrolytic zinc plant with a daily capacity of 150 tons of metallic zinc. The results of operations at the Great Falls plants are given under Silver Bow County with other notes on the company.

Giant Springs district.—A lessee shipped nearly 10,000 tons of old slag containing chiefly silver and lead from the Gibson dump near Great Falls to the lead plant at East Helena.

Montana district (*Neihart*).—Seven lode mines in the Montana district produced 269,901 tons of ore, yielding $7,668 in gold, 674,207 ounces of silver, 1,574,547 pounds of copper, 3,731,428 pounds of lead, and 1,275,491 pounds of zinc, valued in all at $912,920, or $3.38 in metals a ton, a decrease from $1,078,209 in 1926. The output consisted of 117 tons of first-class smelting ore and of 269,784 tons of milling ore which was reduced to 14,352 tons of concentrates. Although most of the ore was milled locally, some was shipped to a custom flotation plant at Butte. The largest producer was the Silver Dyke mine, 3½ miles northeast of Neihart, controlled by the American Zinc-Lead & Smelting Co.

Both the mine and the mill, which is an 850-ton plant equipped for gravity concentration and flotation, were operated the entire year. The mine is opened extensively from a main haulage tunnel; nearly $67,000 was spent in development in 1927. The property is a large producer of silver, copper, and lead—it ranked fourth in production of silver, fifth in lead, and sixth in copper in Montana in 1927. The mill treats copper-lead ore, which is reduced to copper concentrate shipped to Anaconda and to copper-lead concentrate shipped to other smelting plants. An article [5] on the mill operations was published in February. About 4,500 tons of lead-zinc ore was shipped by lessees from the Queen of the Hills property for custom milling. The ore is separated at Butte into lead concentrate and lead-zinc concentrate; the latter is treated in the electrolytic zinc plant at Great Falls. The property is opened by a vertical shaft 300 feet deep and by a mile of other workings, but work in 1927 consisted chiefly of stoping. The property of the Galt Mining Co. produced considerable silver, lead, and zinc from lead-zinc ore shipped to Butte for milling. The mine is opened by a tunnel 1,800 feet long and a 150-foot winze from the tunnel level. As a result of lessees' operations dividends amounting to $2,308 were paid in 1927. The Hartley mine produced two cars of silver ore shipped for smelting, the Florence a car of first-class silver-lead ore, and the Savage property a car of lead-zinc ore which was milled at Butte.

DEER LODGE COUNTY

The copper smelting plant and the copper mill and lead-zinc mill of the Anaconda Copper Mining Co. near Anaconda were active continuously throughout the year, but not at maximum capacity. In fact, the copper milling plant and crushing department of the mill were thoroughly overhauled. Copper ore from Butte and custom material from mines throughout the State were either concentrated at the large mill equipped to treat copper ore by flotation or directly smelted in the large copper plant equipped with reverberatories and converters. The adoption of differential flotation has eliminated jigs and tables and raised the grade of the copper concentrate. The blast furnaces were not used. Lead-zinc ore was also treated in a selective flotation plant at Anaconda, and the lead concentrate was shipped to East Helena while the zinc product went to Black Eagle to be roasted and treated in the electrolytic zinc plant. The construction of a new electrolytic plant at Anaconda, designed to produce 150 tons of metallic zinc a day and similar to that near Great Falls, was begun in May; the plant was completed in record time, and early in 1928 zinc concentrate from Utah was being roasted and leached. The company spent $3,576,981 in constructing this electrolytic plant and in remodeling the copper concentrator and crushing plant.

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[5] Young, G. J., Novel Mining and Milling Methods at the Silver Dyke Property at Neihart, Mont.: Eng. and Min. Jour., vol. 123, Feb. 5, 1927, p. 236.

Dry Gulch district.—A little placer gold was recovered by sluicing at the Dry Gulch claims in Dry Gulch, a tributary of Modesty Creek.

Georgetown district (*Southern Cross*).—Three lode mines in the Georgetown district produced 789 tons of ore, yielding $13,607 in gold and 127 ounces of silver, valued together at $13,679, or $17.34 in metals a ton. Shipments of iron ore containing gold increased considerably from the Holdfast, Southern Cross, and Short Shift mines. The Holdfast property is opened by a 700-foot tunnel and a 450-foot inclined shaft. The ore is hauled by trucks 15 miles to Browns Quarry on the Butte, Anaconda & Pacific Railroad. Lessees shipped a few hundred tons of gold-bearing iron ore from the Southern Cross mine, an old producer owned by the Anaconda Copper Mining Co.; the cyanidation plant was being remodeled. The Short Shift mine was not worked full time, but several cars of iron fluxing material containing more than 40 per cent of iron and nearly 1 ounce of gold to the ton were marketed.

Oro Fino district.—The Cashier group produced two small lots of silver ore shipped for smelting.

FERGUS COUNTY

The mines near Hilger, Giltedge, Brooks, and Kendall were large producers until 1920, but the output has been greatly reduced in recent years, decreasing from $4,778 in 1926 to $3,204 in 1927.

Cone Butte district.—A small lot of siliceous silver ore was shipped from the Dardanelles property by way of Brooks, a station on the Chicago, Milwaukee, St. Paul & Pacific Railroad.

Warm Springs district (*Brooks*).—The Tail Holt property was worked from January to July, and one car of unusually rich gold ore was hauled 13 miles to Brooks. The Silver Queen mine, which is worked by an open cut, produced one car of siliceous silver ore.

GRANITE COUNTY

The value of the mine production of metals in Granite County increased from $181,967 in 1926 to $221,119 in 1927, chiefly because of the milling of several thousand tons of old siliceous silver tailings from the Granite Bimetallic dump near Philipsburg. The large increase in the output of silver more than offset the decreases in lead and zinc, and the output of gold and copper also increased. In 1922 the mines of the county produced metals valued at more than $800,000.

Dunkleberg district.—The output of the Dunkleberg district consisted of several small lots of oxidized lead ore from the Forest Rose property and one car of similar material from the Juno King claim, this ore was hauled to Jens, a station on the Northern Pacific Railway.

First Chance district (*Garnet*).—Four placers and three lode mines in the First Chance district produced 347 tons of ore, $4,818 in gold, and 226 ounces of silver, valued together at $4,946. The ore yielded on the average $11.84 in metals a ton; the placer output was valued at $838. Placer gold was recovered by sluicing operations from the Elfers placer and other claims near Garnet. The Lead King mine was worked a short time by the Garnet Milling & Leasing Co., and a little gold ore was treated experimentally in a 10-stamp concentration plant. One car of highly siliceous gold ore was shipped by a lessee from the Grant & Hartford property of the Butte & Garnet Gold Mining & Milling Co., which has been worked intermittently for 30 years. A car of gold ore was also shipped from the Shamrock claim. Mine products from the First Chance district are hauled to Bearmouth, a station on the Northern Pacific Railway.

Flint Creek district (*Philipsburg*).—Seven lode mines in the Flint Creek district produced 55,572 tons of ore and old tailings, yielding $16,864 in gold, 224,744 ounces of silver, 14,464 pounds of copper, 172,736 pounds of lead, and 336,893 pounds of zinc, valued in all at $178,632, or $3.21 in metals a ton. This production is an increase over the 10,859 tons of ore and old tailings, valued at $158,816, produced in 1926. The output in 1927 consisted chiefly of old tailings reconcentrated but it included also 730 tons of first-class ore and 1,646 tons of concentrating ore. The largest production in the district resulted from the treatment of Granite Bimetallic tailings, which contain chiefly silver, by the Jefferson Milling Co. A 250-ton flotation plant was operated eight months, and more than 1,300 tons of concentrate was shipped to East Helena for smelting. The output of the Granite Bimetallic mine was small when compared with that of former years, but a few hundred tons of silver ore was shipped by lessees to Anaconda and one test lot of lead-zinc ore was treated in a custom plant.

The Silver Prince Mining Co. worked the Scratchall mine and shipped about 1,400 tons of mill ore to Butte, as well as several cars of first-class silver ore for smelting. The lead-zinc ore contains nearly seven times as much zinc as lead. The property is opened by a vertical shaft 500 feet deep; 2,200 feet of development was done in 1927. Two cars of first-class silver ore were shipped from the Trout and Algonquin properties and four cars of lead-zinc milling ore from the Frisco and Old Chief mines; lessees also shipped two cars of sulphide lead ore from the Old Chief property to the smelter at East Helena. The Trout Mining Co. and the Moorlight Mining Co. shipped as usual manganese ore and concentrate for use chiefly in storage batteries. Details regarding the character and treatment of the ore are given by Furness[6] in the chapter on manganese.

Maxville district.—Three lode mines in the Maxville district produced 1,391 tons of ore, yielding $5,629 in gold, 33,852 ounces of silver, 15,417 pounds of copper, and 14,461 pounds of lead, valued in all at $27,753, or $19.95 in metals a ton. The Maxville Gold & Silver

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[6] Furness, J. W., Mineral Resources, 1927, pt. 1, p. 186.

Mining & Development Co. worked the Hoffman mine, 1 mile northwest of Maxville, and shipped several hundred tons of concentrate containing chiefly gold and silver to the smelters at East Helena and Butte. Sulphide copper ore was shipped from the Copper State property and one car of oxidized lead ore from the Bear mine.

Rock Creek district.—Four placers in the Rock Creek district produced $3,423 in gold and 54 ounces of silver, valued together at $3,453. Most of the gold was produced by a lessee at the Basin placer in Basin Gulch, a tributary of Rock Creek. Small lots of placer gold were recovered at the Eureka, Alder, and other claims northwest of Philipsburg.

South Boulder district (*Maxville*).—Three lode mines in the South Boulder district produced 235 tons of ore, yielding $24 in gold, 2,308 ounces of silver, 854 pounds of copper, 20,719 pounds of lead, and 27,238 pounds of zinc, valued in all at $4,493, or $19.12 in metals a ton. Most of the output was milling ore from the Brooklyn property of the Brook-Lead Mines Co. Several cars of lead-zinc ore were shipped to Butte for custom milling. Small lots of sulphide lead ore were shipped by lessees from the Elk and Blue Bell properties.

JEFFERSON COUNTY

The value of the mine production of metals in Jefferson County was $437,711 in 1927, as compared with $578,195 in 1926. The output of gold, silver, copper, and lead was less; there was, however, an increase in the quantity of zinc produced, but the total calculated value of the zinc was slightly less. The Jib mine at Basin, one of the largest producers of gold in Montana in 1924, 1925, and 1926, was idle in 1927; the Western Metallurgical Co., which treated a large quantity of old siliceous silver tailings from the Elkhorn dump in 1925 and 1926, ceased operations December 31, 1926; and the Jefferson Milling Co., treating old tailings from the Alta dump, considerably decreased its output of lead and silver. The most valuable production from Jefferson County in 1927, as in 1926, was that of the Mount Washington mine, operated by the Elm Orlu Mining Co.

Amazon district.—Two cars of first-class silver-lead ore were shipped from the Wilbur Silver property and one small lot of similar ore from the Cleveland prospect.

Bigfoot district.—The Big Four mine on State Creek was idle; the State mine produced a little gold ore which was treated by amalgamation.

Boulder district.—Four lode mines in the Boulder district produced 130 tons of ore, yielding $440 in gold, 2,479 ounces of silver, 1,126 pounds of copper, and 18,655 pounds of lead, valued in all at $3,168, or $24.37 in metals a ton. Several cars of silver-lead ore were shipped by lessees from the Baltimore property. The remainder of the district output consisted of small lots of lead ore from the Ottowa and Molly McGregor properties and one small lot of silver-copper ore from the Copper Ore claim.

Cataract district (*Basin*).—One placer and eleven lode mines in the Cataract district produced 925 tons of ore, $5,814 in gold, 17,586 ounces of silver, 9,385 pounds of copper, 131,673 pounds of lead, and 158,988 pounds of zinc, valued in all at $35,485, a decrease from $148,462 in 1926 due chiefly to the idleness of the Jib mine. The ore yielded on the average $38.26 in metals a ton. The output consisted of 605 tons of concentrating ore which was reduced to 247 tons of concentrates, 319 tons of first-class smelting ore, and 1 ton of ore which was treated by amalgamation. The Crystal mine near Basin produced several hundred tons of lead-zinc ore which was treated at the Timber Butte custom plant at Butte. Three cars of first-class silver ore and lead ore were also marketed. Several lots of exceptionally rich gold ore were shipped from the Mantle property, gold ore of lower grade from the Ruby & Columbia and Bonanza Jack mines, silver ore from the Morning Glory and Johnson claims, gold and silver ore from the Bullion property, sulphide lead ore from the West Rumley and High Ore mines, and lead-zinc ore from the Jenny B. claim. The Hope and Katie mines of the Jib Consolidated Mining Co. produced no ore in 1927. Although the Jib property is equipped with a 300-ton concentration-flotation plant and was the largest producer in the district from 1923 to 1926, no development was done in 1927. A little placer gold was recovered by sluicing operations on Little Pipestone Creek.

Colorado district (*Wickes*).—Four lode mines in the Colorado district produced 37,426 tons of ore and old tailings, yielding $26,903 in gold, 284,629 ounces of silver, 207,689 pounds of copper, 1,362,881 pounds of lead, and 1,107,439 pounds of zinc, valued in all at $372,233, or $9.95 in metals a ton. The value of the output in 1926 was $355,568. The output in 1927 consisted of 1,089 tons of first-class ore smelted and of 28,000 tons of old tailings and 8,337 tons of milling ore reduced to 3,513 tons of concentrates. The Mount Washington mine was operated by the Elm Orlu Mining Co., which shipped several thousand tons of lead-zinc milling ore to Butte as well as a large quantity of first-class lead ore to East Helena. It was one of the largest producers of silver, lead, and zinc outside the Butte district; late in the year the lease was relinquished and the mine returned to its owners. Development consisted of 1,250 feet of work in drifts, raises, crosscuts, and winzes. The milling ore was separated into silver-lead concentrate which was smelted at East Helena and lead-zinc concentrate which was shipped to Great Falls. The Jefferson Milling Co. operated a 200-ton flotation plant on old tailings from the Alta dump at Corbin and shipped more than 1,600 tons of silver-lead concentrate to the lead smelter at East Helena; the output, however, was only about half that of 1926. The Minah and Silver Tip claims each produced one car of silver-lead ore.

Elkhorn district.—Three lode mines in the Elkhorn district produced 2,046 tons of ore and old tailings, yielding $5,347 in gold, 9,673 ounces of silver, and 4,564 pounds of copper, valued in all at $11,429, or $5.59 in metals a ton. With the exception of 532 tons of old tailings shipped for smelting, the entire output was first-class ore. Lessees operated the Golden Curry mine and shipped 1,500 tons of iron ore containing a little gold, silver, and copper; the ore is used as an iron flux at the East Helena smelter. No old tailings from the Elkhorn dump were treated by cyanidation in 1927, but a few hundred tons of this material containing chiefly silver was shipped to Anaconda for smelting. One car of oxidized copper ore containing a little gold and silver was shipped from the Copper King claim at Elkhorn.

Homestake district.—One small lot of ore containing gold and silver was shipped from the Evening Star property, where 225 feet of tunnel work was done.

Lump Gulch district (*Clancey*).—Four lode mines in the Lump Gulch district produced 59 tons of ore, yielding $19 in gold, 4,681 ounces of silver, 102 pounds of copper, 7,962 pounds of lead, and 11,833 pounds of zinc, valued in all at $3,946, or $66.88 in metals a ton. Small lots of rich silver ore were shipped from the Muskegon and Free Coinage properties, one lot of lead ore containing considerable silver was shipped from the Revenue mine, and one car of lead-zinc ore was shipped from the Legal Tender mine for custom milling. Work at the Legal Tender property consisted of 600 feet of drifts in lead-zinc ore chiefly valuable for its silver. The properties in this district are close to the county line between Lewis and Clark and Jefferson Counties and the operators ship ore by way of Clancey on the Great Northern Railway or haul it direct to the East Helena smelter.

Whitehall district.—Five lode mines in the Whitehall district produced 235 tons of ore, yielding $1,086 in gold, 1,312 ounces of silver, 1,099 pounds of copper, and 93,966 pounds of lead, valued in all at $7,894, or $33.59 in metals a ton. The total value in 1926 was $17,064. The entire output in 1927 was first-class smelting ore. Oxidized lead ore was shipped from the Carbonate, Midnight, and Parrott properties, and a little gold ore from the Gold Coin and Sunny Corner claims.

Woodland Park district.—A sample lot of lead ore containing considerable gold was shipped from the Deer Horn claim.

JUDITH BASIN COUNTY

The value of the mine production of metals in Judith Basin County, largely from mines near Monarch, decreased from $318,887 in 1926 to $75,030 in 1927. For a number of years the Block P. property in the Barker district has been the largest producer in the county, but on February 24, 1927, it was sold to the St. Joseph Lead Co. and shipments of concentrates were discontinued, resulting in a large decrease in the output of both silver and lead.

Barker district (*Hughesville*).—Three lode mines in the Barker district produced 3,555 tons of ore in 1927, yielding $1,268 in gold, 34,068 ounces of silver, 707 pounds of copper, 823,094 pounds of lead, and 7,227 pounds of zinc, valued in all at $72,995, or $20.53 in metals a ton, compared with a total value of $318,856 in 1926. This large decrease was due to the closing of the mill on the Block P. property in February. The output of the district in 1927 consisted of 441 tons of first-class ore and of 3,114 tons of concentrating ore which was reduced to 1,064 tons of concentrates. A marked decrease was shown in shipments of lead concentrate from the mill of the Block P. Mining Co., which operated the Wright & Edwards mine in January and February; the ore was treated in an 80-ton gravity concentrator equipped with crusher, rolls, trommels, and Wilfley tables, and two kinds of concentrates were shipped—one containing about 60 per cent of lead and the other only 6 per cent. The working shaft was deepened to the 800-foot level, and approximately 3,000 feet of drifting was done. It is planned to build a new flotation mill in 1928 having a capacity of 400 tons. About $8,000 was spent in development at the Emerald property, which produced more than 350 tons of first-class silver-lead ore. One car of lead-zinc ore was also shipped as a test to the custom flotation mill at Butte. The property is 14 miles northeast of Monarch, a station on the Great Northern Railway. One car of sulphide lead ore was shipped from the Blankenship property of the Monarch Silver & Lead Mining Co. and one car of silver-lead ore from the San Miguel claim of the Faith Mining Co., 5 miles southeast of Hughesville.

Running Wolf Creek district.—Test samples of lead ore were shipped from the Romer property and other claims near Stanford.

Yogo district.—A small test lot of placer gold was recovered by sluicing operations at the Fourth of July claim on Yogo Creek.

LEWIS AND CLARK COUNTY

The value of the mine production of metals in Lewis and Clark County in 1927 was $263,548, or 14 per cent less than in 1926. There was a general decrease in the output of metals other than gold; the production of gold was maintained chiefly by the work of the New Gould Mining Co.

Regular smelting operations were continued at the lead plant of the American Smelting & Refining Co. at East Helena, which is equipped with four blast furnaces. Nearly 6,300 tons of lead bullion a month was shipped east for refining. Custom material chiefly from Montana and Idaho was treated; a large part was sulphide lead ore and concentrate from the Coeur d'Alene region of Idaho. Residues from the zinc plant at Black Eagle derived from zinc products from Montana, Utah, Idaho, and other western States constituted a large part of the receipts. The following paragraph referring to the treatment of zinc-bearing slag at East Helena is taken from the report of the Anaconda Copper Mining Co. for 1927:

> During the year a contract with the American Smelting & Refining Co. was entered into for the treatment of waste slag from the blast furnaces at their plants in Montana and Utah to recover zinc contained in the slag. An experimental plant consisting of a coal dust fired water jacketed furnace, brick flue, steel cooling flue, fans, and bag house was built on the slag dump of the East Helena plant and put into operation at the end of the year. This plant will recover the zinc as a fume which will be sent to the electrolytic zinc plant at Great Falls for final treatment.

The company spent $474,304 to construct the slag plant.

Bald Butte district (*Marysville*).—The output of the Bald Butte district consisted of one small lot of lead ore containing considerable gold from the Bald Butte mine.

Dry Gulch district.—The Homestake property, 3 miles south of Helena, produced one lot of gold ore for smelting, and a little ore was treated by amalgamation in a 2-stamp mill. The Jim Town placer in Kingsbury Gulch was worked about three months, and a little gold was recovered by drifting.

Gould district.—The New Gould Mining Co. continued to work the Jay Gould property and treated more than 11,000 tons of gold ore by amalgamation and concentration. Free gold was recovered on amalgamation plates, and rich table concentrates containing gold and silver were hauled to Silver City, a station on the Great Northern Railway. Development done during the year totaled 1,000 feet. The property ranked fourth as a producer of gold in Montana in 1927.

Grass Valley district.—The Silver Coin mine, worked by a lessee, produced one car of sulphide lead ore rich in silver.

Greenhorn district.—The King Tut property near Austin produced several hundred tons of iron ore containing gold, silver, and a little lead. This material was shipped to the smelter at East Helena, where it was used as a flux.

Heddleston district.—One car of sulphide lead ore was shipped from the Carbonate property on Big Blackfoot River, 50 miles northwest of Helena. The Mike Horse property produced one car of sulphide lead ore, and two cars of lead-zinc mill ore were treated at Butte. About 140 feet of drifting was done in the mine, but the old concentration plant was not operated. The property is owned by the Sterling Mining & Milling Co. and is 33 miles northwest of Silver City, the shipping point on the Great Northern Railway.

Lincoln district.—The Harvey placer in Sauerkraut Gulch and the Bloom & Old Billy Williams property in McClellan Gulch produced a little placer gold by sluicing operations.

Ottawa district (*Marysville*).—One placer and seven lode mines in the Ottawa district produced 22,296 tons of ore and old tailings, $125,656 in gold, 31,427 ounces of silver, 4,853 pounds of copper, 67,429 pounds of lead, and 22,137 pounds of zinc, valued in all at $149,776, compared with a total value of $161,749 in 1926. The total ore and old tailings in 1927 yielded on the average $6.72 in metals a ton. Of the total output in 1927, 20,637 tons was ore and 1,063 tons was old tailings treated by cyanidation, 126 tons was ore treated by amalgamation, 346 tons was first-class smelting ore, and 124 tons was concentrating ore which was reduced to 77 tons of concentrates. Most of the output from the Ottawa district is shipped from Silver City on the Great Northern Railway. Most of the gold and silver in 1927 was recovered by cyanidation at the Drumlummon property of the St. Louis Mining & Milling Co. of Montana. More than 20,000 tons of gold ore was treated in an 80-ton plant by fine grinding and agitation in cyanide solution. The property ranked third as a producer of gold in Montana in 1927, despite the fact that no development other than stoping was done during the year. Precipitates containing gold and silver were recovered from the treatment of old Drumlummon tailings.

Several hundred tons of rich gold ore of smelting grade and a little gold bullion were produced at the Piegan-Gloster property, a large producer of both gold and silver in the past. Gold ore was mined by lessees at the Cruse & Bald Mountain property and was treated by cyanidation in the mill of the St. Louis Mining & Milling Co. Development done at the Earthquake and General Grant claims of the Home Mining & Milling Co. produced one car of sulphide lead ore; the property was worked nearly the entire year, and more than $4,000 was spent in development. The Big Ox Mining Co. shipped one car of first-class lead ore, and three cars of lead-zinc ore were treated in a custom plant at Butte. A little drifting was done at the Resurrection placer in Trinity Gulch, but only a small sample of gold was recovered.

Stemple district.—A little placer gold was recovered from claims on Virginia Creek near Stemple.

Unionville (*Helena*) *district.*—Two placers and five lode mines in the Unionville district produced 489 tons of ore, $8,108 in gold, 108 ounces of silver, and 341 pounds of copper, valued in all at $8,213. The ore yielded on the average $16.30 in metals a ton. The output was chiefly first-class smelting ore but it included also 39 tons of ore treated by amalgamation. The Spring Hill group, a large producer of gold in the early days of mining, was worked by the Montana-Idaho Mines Corporation. The corporation shipped more than 400 tons of gold ore for smelting and did nearly 500 feet of adit work. In October the company started to build a new 175-ton cyanidation plant; this was completed early in 1928. It is planned to grind the ore to pass through a 100-mesh screen, to treat it in Dorr agitators and thickeners, and to precipitate the gold in a Sperry precipitation press. A little gold ore from the old Whitlatch mine was treated by amalgamation, and several small lots of similar ore were shipped to East Helena for smelting. Sample lots of ore containing gold and silver were shipped from the Ella No. 2, Eastern Star, and other small claims. The placer output consisted of miscellaneous small lots of gold recovered from claims on Nelson Gulch.

Vaughn district (*Rimini*).—Four lode mines in the Vaughn district produced 55 tons of ore, yielding $381 in gold, 2,513 ounces of silver, 667 pounds of copper, 10,174 pounds of lead, and 7,394 pounds of zinc, valued in all at $3,007, or $54.67 in metals a ton. One car of rich silver ore was shipped from the Peerless Jennie mine, small test lots of gold ore were shipped from the Aurora claim, and a little lead ore was shipped from the Quimby claim. One car of lead-zinc ore from the Stanton (Tatam) property was shipped to Butte for milling.

Wolf Creek district.—The New Era group, owned by the Montana Copper & Zinc Co., a regular producer of copper ore in 1926, produced only three cars of first-class sulphide copper ore in 1927. The material was shipped by way of Wolf Creek, a station on the Great Northern Railway.

LINCOLN COUNTY

The value of the mine production of metals in Lincoln County decreased from $83,496 in 1926 to $65,050 in 1927 as a result of the decrease in the output of lead, gold, and silver.

Libby district.—Development was done at the Lukens Hazel mine, formerly a producer of silver-lead ore, but no ore or concentrate was shipped in 1927. A small sample lot of ore was shipped from the Gold Standard property or Herbert's Gold mine, 25 miles south of Libby at the head of the West Fisher River. The ore contains considerable free gold, about $80 to the ton, which occurs with galena, sphalerite, and pyrite in a quartz gangue. It is planned to develop the vein, which is 20 inches thick, and haul the product to Libby, possibly after eliminating the silica. In 1927 the Midas gold property was virtually idle, but early in 1928 it again became a producer of gold bullion.

Troy or Callahan Creek district.—The Snow Storm Silver Lead Co., owning property north of Troy, a station on the Great Northern Railway, was a comparatively small producer, as the 500-ton mill which was used as a custom flotation plant in 1926 was destroyed by fire May 6, 1927. Several thousand tons of lead-zinc ore from the Big Eight mine was concentrated in the Snow Storm mill; lead concentrate was shipped to East Helena and zinc concentrate to an eastern zinc plant. About $4,000 was spent in drifting on the vein that contains galena and sphalerite.

MADISON COUNTY

The value of the mine production of metals in Madison County increased from $116,767 in 1926 to $246,433 in 1927 as a result of the operation of the mine and mill of the Liberty Montana Mines Co. from May to December. The property, which is 15 miles south of Jefferson Island, again became a large producer of gold.

Alder Gulch district (*Virginia City*).—Two placers and five lode mines in the Alder Gulch district produced 584 tons of ore, $4,840 in gold, 9,178 ounces of silver, 19 pounds of copper, and 4,924 pounds of lead, valued in all at $10,356. The ore yielded on the average $17.11 in metals a ton and consisted of 134 tons of first-class smelting ore and 450 tons of ore treated in amalgamation mills. Several cars of ore containing chiefly silver were shipped from the Native Silver mine, operated by the Barton Gulch Mining Co. The mine is opened to a depth of 200 feet, and 1,110 feet of development was done in 1927. Gold bullion was shipped to Helena as a result of work done at the High Up property by the Soco (Inc.). Several hundred tons of gold ore was treated in a mill equipped for amalgamation and cyanidation. A sample lot of silver-lead ore was shipped from the Abe Silver-Lead property, and small samples of gold ore were shipped from the Cornucopia and Wakusta claims. About 200 feet of drifting was done at the Alhambra group, which is equipped with a small stamp mill and a Wilfley table. The output of placer gold was unusually small compared with that of past years and consisted of small lots of gold dust and bullion resulting from sluicing operations at the Eggert and Peterson claims near Virginia City.

Bone Basin district.—One car of sulphide copper ore was shipped from the Florence mine near Renova.

Lower Hot Springs district (*Norris*).—A small car of rich gold ore from the Josephine mine was shipped to Anaconda for smelting. Sinking was continued at the Golden Treasure property.

McCarthy Mountains district.—Three lode mines in the McCarthy Mountains district produced 80 tons of ore, yielding $6,051 in gold, 3,860 ounces of silver, and 45,615 pounds of lead, valued in all at $11,114, or $138.93 in metals a ton. All the output was first-class smelting ore and consisted chiefly of oxidized lead ore and siliceous gold ore. The Hidden Treasure property near Glen produced three lots of gold ore containing on the average more than 10 ounces of gold to the ton; this ore was shipped to the smelter at East Helena. Two cars of silver-lead ore were shipped from the Polly Jane and B. B. & I. E. claims, 14 miles west of Twin Bridges. A small lot of lead ore containing considerable silver was shipped from the Mountain View property by way of Glen, a station on the Oregon Short Line Railroad.

Mineral Hill district.—The Liberty Montana Mines Co. operated its Mammoth property south of Jefferson Island from May until December. The 100-ton mill equipped with concentration tables and flotation cells treated more than 18,000 tons of copper ore. Copper concentrate rich in gold was shipped to Anaconda for smelting and brought the company $125,000 after freight and treatment charges had been paid.

Norwegian district.—One car of gold ore was shipped from the Red Chief property from Shaws Spur on the Northern Pacific Railway. The Parrish Mining Co. worked the Norwegian placer on Norwegian

Creek, 6 miles northwest of Norris, and produced a little gold by sluicing during March and April.

Rabbit district.—Seven lode mines in the Rabbit district produced 395 tons of ore, yielding $1,407 in gold, 7,557 ounces of silver, 1,249 pounds of copper, and 206,947 pounds of lead, valued in all at $18,894, or $47.83 in metals a ton. The entire output was first-class smelting ore, chiefly from the Calvin property, 6 miles east of Melrose on the south fork of Camp Creek; this property was reported as in the Camp Creek district in 1926. About 200 tons of oxidized lead ore was shipped early in the year when the property was under lease, but the Commonwealth Lead Mining Co. took possession of the property under bond and lease in October. Other shipments of ore were made late in the year and early in 1928 the company opened new ore and made regular shipments to a lead smelter in Utah. One car of oxidized lead ore was shipped from the Jack Rabbit property, 1 mile south of Camp Creek near Melrose, and small lots of gold ore were shipped from the Cordell, King, Watseka, and California claims.

Ramshorn district.—Two placers and four lode mines in the Ramshorn district produced 50 tons of ore, $986 in gold, 1,755 ounces of silver, and 16,530 pounds of lead, valued in all at $3,023. The ore yielded on the average $50.38 in metals a ton and consisted of one car of silver-lead ore shipped from the Bedford property in Ramshorn Gulch southeast of Sheridan, one car of gold and silver ore shipped from the Ellajay property, a small lot of rich silver ore from the Silver King claim on Horse Creek, and a small lot of gold concentrate from the First Chance claim, 14 miles southeast of Sheridan.

Red Mountain district.—The Gold Nugget placer, 12 miles east of Melrose, was worked by sluicing and yielded about $1,300 worth of gold.

Sheridan district.—Four lode mines in the Sheridan district produced 1,354 tons of ore in 1927, yielding $10,080 in gold, 1,013 ounces of silver, 83 pounds of copper, and 18,814 pounds of lead, valued in all at $11,850, or $8.75 in metals a ton, compared with a total value of $51,270 in 1926. Most of the ore in 1927 was treated by concentration, but 300 tons was treated by amalgamation, and 54 tons was shipped for smelting. The Gladstone Mines & Reduction Co. worked the Gladstone mine, 11 miles from Sheridan, the entire year. The 100-ton concentration plant was operated eight months on ore that contained chiefly gold. Rich gold concentrate was shipped to both East Helena and Anaconda. About $15,000 was expended for further development of the mine, which is opened by a tunnel 4,000 feet long. About 300 tons of low-grade gold ore were treated by amalgamation and concentration at the Tamarack property, 5 miles from Sheridan. A little work was done in drifting, but operations ceased in October and the Tamarack Mining Co. was dissolved.

Silver Star district.—Four lode mines in the Silver Star district produced 34 tons of ore, yielding $981 in gold, 62 ounces of silver, and 54 pounds of copper, valued in all at $1,023, or $30.09 in metals a ton. The output consisted of one car of gold ore from the Edgerton property near Silver Star, test lots of gold ore from the Fitzgerald and Fool Hen claims, and one small lot of gold ore treated by amalgamation from the Strawn group.

Summit district (Virginia City).—Gold was recovered from the Gilman claims as a result of cleaning up an old mill site, and a little gold ore and gold bullion were shipped from the Winnetka claim of the Madison Mining Co.

Tidal Wave district (*Twin Bridges*).—Ten lode mines in the Tidal Wave district produced 186 tons of ore, yielding $16,642 in gold, 2,659 ounces of silver, and 34,078 pounds of lead, valued in all at $20,297, or $109.12 in metals a ton. The largest output was that of the Corncracker property, which produced more than 100 tons of unusually rich gold ore shipped for smelting. Lessees working the property did about 80 feet of raising and hauled the ore 8 miles west to Twin Bridges, a station on the Northern Pacific Railway. About 4 tons of gold ore averaging 13 ounces of gold to the ton were shipped from the High Ridge Fraction claim, and a test lot of similar material came from the Pine Mountain property. One car of gold ore was shipped from the Pete & Joe property of the Mohave Mining Corporation, formerly a large producer. Several lots of oxidized lead ore were shipped from the Ella, Bay State, and Van Meter Lode claims, and a small lot of silver ore containing considerable gold was shipped from the Keynote claim, 7 miles from Sheridan. A little gold ore from the Shoemaker and Georgia Gulch properties was treated by amalgamation.

Upper Hot Springs district (*Norris*).—The output of the Upper Hot Springs district came from five lode mines and consisted of small test lots of gold ore and copper ore valued at $414. A little oxidized copper ore rich in gold came from the Blue Grouse and Copper Queen claims, and gold ore from the Primrose mine, 6 miles southwest of Norris, and from the Mountain View & Mascot and Wilson & Rice claims.

Washington district.—Three lode mines in the Washington district produced 1,019 tons of ore, yielding $12,387 in gold, 1,038 ounces of silver, 92 pounds of copper, and 1,530 pounds of lead, valued in all at $13,083, or $12.84 in metals a ton. Most of the output came from the Missouri mine worked by the Montana Gold & Silver Mining & Milling Co. About 1,000 tons of gold ore was treated by amalgamation, concentration, and cyanidation in a 30-ton plant. Gold bullion was shipped to Helena, Mont., and Denver, Colo., and a small lot of rich concentrate was shipped to the lead plant at East Helena.

MEAGHER COUNTY

Beaver Creek district.—A little placer gold was recovered from drifting in bench gravel at the Gehu claim on Beaver Creek.

Castle Mountain district.—Nearly 1,400 tons of old slag containing chiefly lead was shipped by a lessee from the Yellowstone dump, 8 miles northwest of Lennep.

Musselshell district.—One car of sulphide copper ore was shipped from the Capitol Hill property by way of White Sulphur Springs, and one small lot of similar ore was shipped from the Lucky Boy property near Delpine.

MINERAL COUNTY

The value of the mine production of metals in Mineral County decreased from $122,416 in 1926 to $27,369 in 1927, chiefly because of the large decrease in the output of lead-zinc ore from the Iron Mountain property, 4 miles north of Superior.

Cedar Creek district (*Iron Mountain, Quartz*).—Three placers in the Cedar Creek district produced gold valued at $1,156. The gold was recovered chiefly by sluicing at the Eddy, Stockholm, and Windfall claims. Some of the gold is so fine that it is almost chemically pure. The Higley Mining Co. acquired the Eddy and Lackawanna properties and spent $50,000 in prospecting the property and installing two modern hydraulic plants.

Iron Mountain district (*Superior, Iron Mountain*).—Two lode mines in the Iron Mountain district produced 444 tons of ore, yielding $37 in gold, 10,198 ounces of silver, 146,603 pounds of lead, and 162,147 pounds of zinc, valued in all at $25,432, or $57.28 in metals a ton. The Iron Mountain Mining Co. operated the Iron Mountain property, owned by the Federal Mining & Smelting Co. Three cars of first-class lead ore were shipped to East Helena for smelting, and 300 tons of lead-zinc ore was shipped to Butte for custom milling. The 150-ton flotation-concentration plant on the property, which was rebuilt in 1925, was idle in 1927, but the company received $15,427 from the sale of first-class ore and concentrating ore. A test lot of lead-zinc ore from the Nite Owl claim was shipped to Butte for testing by flotation.

St. Regis district.—The Lead Hill Mines Corporation operated the Rock Island property on Rock Creek near Deborgia. A large quantity of lead ore is being developed at the mine; one car of sulphide material was shipped to Bradley, Idaho, for smelting.

MISSOULA COUNTY

Coloma district.—A little placer gold was recovered from the northern part of Elk Creek beyond the line between Missoula and Granite Counties.

Nine Mile district.—Three placers in the Nine Mile district produced gold valued at $511. The Marion Creek placer near Stark was the chief producer, but other prospects on McCormick Creek yielded a little exceptionally rich placer gold.

PARK COUNTY

The value of the mine production of gold and silver in Park County decreased from $111,780 in 1926 to $2,388 in 1927, as the mine and mill of the Jardine Mining Co. were idle the entire year. In 1925 the value of the county mine production, chiefly from gold-arsenic ore of the Jardine mine, was $294,248.

Emigrant Creek district.—A small output of gold was recovered from the Yellowstone placer at Emigrant.

Sheepeater district (*Jardine*).—The Jardine mine, a large producer of gold since 1918 and of arsenic since 1923, was idle in 1927. No work was done at the mine besides repair work, and, with the exception of a clean-up of rich gold slimes from former operations and 8 tons of scheelite concentrates, no products were marketed. The ore consists chiefly of arsenopyrite containing gold. In past years free gold was saved on amalgamation plates and concentrate rich in gold was shipped for smelting. In 1923 arsenic roasters and kitchens were added so that white arsenic could be made. Scheelite, calcium tungstate, occurs in some of the ore, and about 40 tons of this material was concentrated in 1927 as a test. The ore was crushed in the stamp mill, roasted in a reverberatory furnace, and concentrated on a James table. The concentrate, which assayed 72 per cent of tungsten trioxide, was shipped to Latrobe, Pa. The annual report of the Jardine Mining Co. for 1927 says:

> During the year 1927 the mill and arsenic plant were operated only to treat tungsten ore on hand and to refine stocks of crude arsenic remaining from previous operations. * * *.
>
> The depression through which the arsenic market was passing at the time of our last report is much relieved, and the market is now becoming not only firm but prices are somewhat higher. * * *.
>
> During the year two legal actions of serious import were finally decided in our favor. * * *.
>
> From 1922 until 1926, 223,440 tons of ore were milled at an average cost of $4.40 a ton. Estimated reductions that can be made bring the possible future costs down to $3.41 a ton.
>
> The company reported the following sales in 1927: Arsenic, $15,676; tungsten, $5,000; cyanide gold, $2,024.

PHILLIPS COUNTY

Little Rockies district.—The mines of the Little Rockies district, formerly large producers of gold and silver, were practically idle in 1927. A sample lot of exceptionally rich gold ore was shipped from Mine No. 96, a prospect near Zortman, and a little bullion containing gold and silver was cleaned up from the old plant of the Beaver Creek Mining Co.

POWELL COUNTY

The mine production of metals in Powell County was valued at $29,041 in 1927, an increase of $9,621 over 1926, chiefly in the output of gold.

Big Blackfoot district.—Placer gold and silver valued at $2,094 was recovered in the Big Blackfoot district in 1927, chiefly from the Gold Dust (McCormick) property on Ogden Mountain. The property was worked about two months by hydraulic mining.

Nigger Hill district (*Elliston*).—Four lode mines in the Nigger Hill district produced 104 tons of ore, yielding $2,187 in gold, 2,480 ounces of silver, 240 pounds of copper, and 36,975 pounds of lead, valued in all at $5,955, or $57.26 in metals a ton. The entire output was first-class smelting ore shipped chiefly from the Big Dick and Flora groups. The Continental Divide Consolidated Mining Co. shipped two cars of gold ore containing a little lead from the Big Dick property, and several lots of sulphide lead ore containing silver were shipped from the Flora mine near Hat Creek, 7 miles south of Elliston.

Pioneer district (*Gold Creek*).—Eight placers and two lode mines in the Pioneer district produced 41 tons of ore, $11,777 in gold, and 171 ounces of silver, valued together at $11,874. The ore yielded on the average $196.27 in metals a ton. The Independence mine, 16 miles south of Gold Creek, was worked for 7 months and the mill, a small amalgamation and concentration plant, for 15 days. A little gold bullion was recovered on plates and shipped to the assay office at Helena, and a small lot of exceptionally rich gold concentrate was shipped to Anaconda for smelting. A little work was done in drifting on the vein, but severe winter weather stopped operations in November. A little gold was recovered from a test lot of ore treated by amalgamation at the Pioneer group. The placer output was valued at $3,827 and came chiefly from the Friday claim on Gold Creek.

Washington Gulch district.—Placer gold was recovered from claims in Washington Gulch and American Gulch near Finn.

Zozell district.—The Blue Eyed Maggie property, 10 miles east of Deer Lodge, was not worked vigorously, but lessees shipped four cars of ore containing chiefly gold and silver. One car of gold ore and two cars of lead ore containing gold and silver were shipped from the Bonanza mine by the Bonanza Mining Corporation, and a car of lead-zinc ore was shipped to Butte for treatment in the Timber Butte flotation plant.

RAVALLI COUNTY

Overwich district (*Hughes Creek*).—A little placer gold was recovered from claims on Hughes Creek, near Hamilton.

SANDERS COUNTY

The value of the mine production of metals in Sanders County, part of which borders on the Coeur d'Alene region of Idaho, declined from $13,418 in 1926 to $1,349 in 1927.

Blue Creek district.—A test lot of lead-zinc ore was shipped from the Broken Hill property to the Sweeny custom plant near Kellogg, Idaho, the equipment of which was changed in order to make lead concentrate and zinc concentrate.

SILVER BOW COUNTY

Forty-five mines in Silver Bow County were productive in 1927, but most of the metal output resulted from the operations of seven companies at Butte. Although nearly all the large producing mines at Butte were active throughout the year, the output of all metals except zinc decreased considerably. The output of copper decreased more than 31,600,000 pounds on account of the low market price of the metal. The larger part of the ore and old tailings mined or treated was concentrated at milling plants at Butte and Anaconda; the resulting products consisted of copper concentrates, lead concentrates, zinc concentrates, and lead-zinc concentrates. These yielded metals valued at $44,327,096, or $50.03 to a ton of concentrates. The crude smelting ore yielded on the average $13.68 in metals a ton. No ore was treated by amalgamation or cyanidation. Old copper tailings and slime-pond material, amounting to 28,888 tons, were smelted. Of the total output of ore, old tailings, etc., in the county 78 per cent was classified as copper material.

Mine production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1926–27

Year	Mines producing	Ore, old tailings, etc.	Gold (lode and placer)	Silver (lode and placer)	Copper [1]	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1926	46	3,985,585	$679,637	11,060,900	252,990,866	27,356,608	143,305,702	$55,936,816
1927	45	3,753,246	543,939	9,659,142	221,311,535	25,537,495	156,627,681	46,645,518

[1] Includes copper recovered from precipitates, as follows: 1926, 5,014,108 pounds; 1927, 4,515,407 pounds.

Divide Creek district.—Six lode mines in the Divide Creek district produced 75 tons of ore, yielding $2,595 in gold and 923 ounces of silver, valued together at $3,118, or $41.57 in metals a ton. The entire output consisted of first-class smelting ore and was chiefly gold ore from the Gold King property.

German Gulch district.—Placer gold from claims in German Gulch was sold in small lots to assayers at Butte.

Summit Valley or Butte district.—Thirty-seven lode mines in the Summit Valley district produced 3,753,171 tons of ore, old tailings, etc., which yielded $540,827 in gold, 9,658,204 ounces of silver, 221,311,535 pounds of copper (including 4,515,407 pounds from precipitates), 25,537,495 pounds of lead, and 156,627,681 pounds of zinc, valued in all at $46,641,874. Excluding the value of the copper recovered from precipitates, the ore, old tailings, etc., yielded on the average $12.27 in metals a ton. In 1926 the total value of the metal output was $55,934,190. The output in 1927 consisted of 113,035 tons of first-class smelting ore, of 28,888 tons of old tailings and pond slimes smelted, and of 3,610,669 tons of concentrating ore which, with 579 tons of old tailings, was reduced to 886,069 tons of concentrates. The mines at Butte have been large producers for more than 40 years, and rich ore is still being mined at great depth.

From the beginning of activities in 1882 to the end of 1927 Silver Bow County, which includes the Butte district, has yielded gold, silver, copper, lead, and zinc valued at $2,001,504,081, as follows: Gold, $35,676,926; silver, $315,025,369; copper, $1,442,275,089; lead, $18,293,633; and zinc, $190,233,064. These values represent 1,725,871.25 ounces of gold, 432,089,916 ounces of silver, 9,363,754,210 pounds of copper, 268,070,142 pounds of lead, and 2,290,431,415 pounds of zinc.

The mines of the Anaconda Copper Mining Co. according to the printed annual report for 1927 produced 2,956,003 tons of copper ore and precipitates and 16,519 tons of zinc ore, a total of 2,972,522 tons in 1927, compared with 2,570,450 tons and 17,676 tons, respectively, a total of 2,588,126 tons in 1926. The concentrators treated 2,866,785 tons of copper ore and 480,166 tons of zinc ore. The Anaconda works produced 221,300,270 pounds of fine copper, 6,638,127 ounces of silver, and 32,674.09 ounces of gold; the greater part of this output came from the copper mines of the Anaconda Copper Mining Co. at Butte. A large quantity of silver and copper was recovered by the treatment at Anaconda of old tailings and slimes from ponds near the smelter.

The company owns a large area at Butte and works other property under lease, such as the Emma mine; it obtained control of the Anselmo mine in 1926. A general description of the geology, mining methods, underground workings, and reduction works is given in the Mines Handbook.

The electrolytic copper refinery at Great Falls produced 245,402,154 pounds of cathodes, most of which were melted into shapes at Great Falls. The metal output of the plant was 378,099,665 pounds of fine copper, 18,896,528 ounces of silver, and 147,437.95 ounces of gold. The extension of the electrolytic copper refinery was completed during 1926, and the capacity of the plant is now 312,000,000 pounds of cathodes per annum. The rod and wire mill at Great Falls rolled 165,954,810 pounds of copper into rods; 36,940,088 pounds of rods were drawn into wire, of which 19,839,667 pounds were made into strand. In addition to the rods used locally 45,926,821 pounds of rods were shipped from the mill to the Kenosha plant of the American Brass Co. to be drawn into wire.

During the year 600,354 tons of zinc ore and concentrates were treated in the zinc plants. Of this amount 12,913 tons of ore was from the mines of the company and 587,441 tons of ore and concentrates were purchased from other producers in Montana, Utah, and Idaho. The electrolytic zinc plant produced 225,133,444 pounds of slab zinc, 12,403,407 pounds of zinc in dross, and residue from which were recovered 20,438,939 pounds of lead, 2,037,910 pounds of copper, 3,008,126 ounces of silver, and 7,307.89 ounces of gold. Dividends amounting to $9,000,000 were paid in 1927 by the Anaconda Copper Mining Co., and the net income for the year was $10,123,258, which, added to the balance at the end of the year 1926, gives a surplus of $86,048,370 after deduction of dividends. The company's annual report says:

> Work of remodelling the Anaconda concentrator to treat ore by selective flotation was completed in August, materially increasing the grade of concentrates and reducing smelting costs. A central crushing plant was completed during December, feeding two sections by the end of the year, and will be extended to other sections in 1928. * * *.
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> Construction at Anaconda of a new electrolytic zinc plant of 150 tons daily capacity was begun in May, 1927, and was completed. Production therefrom began in February, 1928.

As in the past, the company also did a large business in lumber, coal, fertilizer, arsenic, and sulphuric acid in Montana; in manufacturing and refining in the east; mining, milling, and smelting in Utah, Arizona, California, and Colorado; and mining and milling in South America and Europe. The new hoist installed at the Belmont mine at Butte, capable of lifting 146 tons of ore per hour from a maximum depth of 5,200 feet, was described in an article[7] issued in September.

The Anselmo property, owned by the Anaconda Copper Mining Co., was worked throughout the year and produced both copper and zinc ore, which was milled at Anaconda. The chief product was about 12,000 tons of copper concentrate smelted at Anaconda and several hundred tons of zinc concentrate shipped to Great Falls. The production increased considerably in 1927, and the mine ranked third as a producer of copper and ninth as a producer of silver in Montana.

The Anaconda Copper Mining Co. continued to operate the Emma mine of the Butte Copper & Zinc Co. The chief output of the mine was lead-zinc ore, which was shipped to Anaconda for milling. The high-grade lead concentrate is separated and shipped to East Helena for smelting, and the lead-zinc concentrate is shipped to the electrolytic plant at Great Falls. The property was again the largest producer of lead in Montana; it was third in the production of zinc, sixth in the output of silver, and eighth in gold. Nearly 8,000 short tons of manganese ore was also produced at the property and shipped to eastern steel plants. The Butte Copper & Zinc Co. received $87,171 from 145,853 tons of lead-zinc ore and manganese ore. The net income for the year was $58,310, but no dividends were paid. The following paragraphs are taken from the printed report of the Butte Copper & Zinc Co. for 1927:

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[7] Woodward, C. D., Electric Hoist at the Belmont Mine, Butte: Min. and Met., vol. 3, September, 1927, p. 380.

> During the year the Rarus fault has been cut, finding ore of high grade beyond it. The developments at depth have opened up high-grade ore bodies. The main shaft is now down 1,650 feet and the company has started crosscutting to the 1,800-foot level of the Original mine of the Anaconda and have strong hopes of opening up additional new high-grade ore bodies. In addition a 5-year contract for the treatment of all our manganese ores has been concluded at prices which should net the company a satisfactory profit. This contract calls for the mining of about 400,000 short tons during the 5-year period, and the company has the right to increase this production if so desired.

The Eveline & Twilight property, owned by the Clark-Montana Realty Co., produced more than 1,000 tons of siliceous silver ore which was smelted at Anaconda and about 1,500 tons of lead-zinc ore which was milled at the Timber Butte plant at Butte. The mine was closed for an indefinite period after September. The property is opened by a vertical shaft and other workings, and 2,125 feet of drifts and 987 feet of crosscuts were run during the year.

The Black Rock property of the Butte & Superior Mining Co. was worked throughout the year and produced zinc ore and copper ore which was treated in the mill at Anaconda. An increase was recorded in the quantity of zinc ore mined, but there was a decided decrease in the quantity of copper ore shipped. The property was the largest zinc producer and second in the production of silver and lead in Montana in 1927 as well as in 1926; it was fourth in the production of copper and fifth in gold in 1927. During the year the company paid dividends amounting to $580,395, or a total of $19,116,740 to date. As a result of ore sales the company received $2,670,697. The cost of mining, development, and general expenses was $2,360,803, leaving an operating profit of $309,894, or a net income, without deduction for depletion, of $272,911. The following paragraphs are taken from the company's printed report for 1927:

> Development work consisted of 22,722 feet of drifts and crosscuts, 6,078 feet of raises, and 288 feet of shaft and station development, or a total of 29,088 feet.
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> The estimated ore reserves at the end of 1927 were 178,280 tons of zinc ore and 4,214 tons of copper ore.
>
> The production of copper ore was 37,953 tons, containing 177 ounces of gold, 212,997 ounces of silver, and 2,785,353 pounds of copper, * * *.
>
> The production of zinc ore was 313,841 tons, containing 1,819 ounces of gold, 1,821,564 ounces of silver, 1,246,306 pounds of copper, 7,962,320 pounds of lead, and 79,786,788 pounds of zinc.

The Pittsmont mine of the East Butte Copper Mining Co. east of Butte was worked the entire year and was a large producer of silver and copper. The entire output in 1927 (chiefly copper ore) was shipped to Anaconda for milling and smelting, as both the milling plant and the smelting plant at Pittsmont have been idle since August, 1924. Part of the ore contained enough copper to be directly smelted; several hundred tons of zinc ore of milling grade was also shipped to Anaconda. The property is opened by three vertical shafts, the deepest of which is 2,440 feet, and development in 1927 consisted of 7,545 feet of drifts, crosscuts, and raises. The ore, which is all sulphide, contains quartz, pyrite, enargite, and chalcocite. No dividends were distributed in 1927, but the company has paid $1,676,370 in the past. From the Pittsmont property the company mined 69,520 dry tons of copper ore, averaging 4.79 per cent of copper and 5.76 ounces of silver to the ton. The metal content was reported as 6 ounces of gold, 348,985 ounces of silver, and 5,844,769 pounds of copper, but no statement was published giving the results after milling and smelting the ore at Anaconda. The company also shipped 629 tons of zinc ore, averaging 5.75 per cent of zinc, 0.22 per cent of lead, and 6.18 ounces of silver to the ton. The gross value of the ores shipped in 1927 was $491,939, but the operating cost was $592,530. The company, which also operates property in Colorado and Nevada, made the following statement regarding the Pittsmont mine at Butte in its annual printed report for 1927:

> Development work performed during the year consisted of 7,642 lineal feet of crosscutting, drifting, and raising, and the amount expended was $171,501.30.
> * * *
>
> The deficiencies found in the downward extensions of the most important ledges do not lend much encouragement to prospects for the future, and it may be said without hesitation that this regrettable situation has developed in spite of vigorous prospecting, increased efficiency, and improved mining methods.

The Elm Orlu Mining Co. operated its mine at Butte the entire year and shipped a large quantity of lead-zinc ore to the Timber Butte Milling Co.'s plant south of Butte; both the mine and the mill are under the control of the Clark interests. The ore is separated into a lead concentrate which is shipped to a lead smelter and a zinc concentrate which is treated in the electrolytic zinc plant at Great Falls. Part of the ore mined was sulphide copper ore shipped to Anaconda to be milled. The mine ranked second in the production of zinc in Montana in 1927, third in silver, fourth in lead, and seventh in copper. The property is opened by a vertical shaft 3,400 feet deep, and development in 1927 consisted of 3,769 feet of drifts, 3,172 feet of crosscuts, and 1,775 feet of raises. Although the mine has been one of the largest producers of zinc in Montana since 1914, the company has never issued a printed report giving details of operations.

The custom flotation mill at Timber Butte south of Butte was active throughout the year, treating ore chiefly from the Elm Orlu, Poser, Moulton, and Otisco properties; it also treated much custom material from mines in various other counties, especially in Jefferson, Cascade, and Granite Counties. The plant treated nearly 350,000 tons of ore in 1927 and made two grades of concentrates—a high-grade silver-lead product for smelting and a high-grade zinc product for treatment by roasting and electrolysis.

The Goldsmith mine of the Crystal Copper Co. was operated under lease by the Clark-Montana Realty Co. About five cars of first-class silver ore were shipped for smelting and a few hundred tons of lead-zinc ore was milled, but the output was small compared with that of 1925 and 1926. More than 1,000 feet of development, chiefly in drifts, was done by the leasing company in 1927.

The Lizzie mine owned by the Hickey estate produced more than 600 tons of sulphide copper ore of smelting grade and about 750 tons of lead-zinc ore of milling grade containing on the average about 17 per cent of zinc, 2 per cent of lead, and 2 ounces of silver to the ton.

More than 1,500 tons of lead-zinc ore containing considerable zinc and silver was shipped by lessees from the Magnolia property of the Anaconda Copper Mining Co. to the Timber Butte mill.

The Poser mine was operated the entire year through the shaft of the Elm Orlu mine, and more than 125,000 tons of lead-zinc ore was shipped to the Timber Butte mill for treatment by flotation. The output was considerably larger than that of 1926, which was in turn a decided increase over that of 1925. In 1927, as in 1926, the mine was the third largest producer of lead and the fourth largest producer of zinc in Montana; it ranked fifth in the output of silver in Montana in 1927. Nearly 7,000 feet of work was done in drifts, crosscuts, and raises.

The Moulton mine was worked from January to September and produced nearly 27,000 tons of ore, nearly all lead-zinc milling ore. As a result considerable silver, lead, and zinc were recovered from concentrates shipped to East Helena and Great Falls. The company received $122,925 from the sale of milling ore and a little siliceous silver ore; the total metal output was less than that of 1926. Development in 1927 consisted of 2,593 feet of crosscuts, 1,437 feet of drifts, 864 feet of raises, and 1,234 feet of diamond drilling.

The North Butte Mining Co., which owns the Granite Mountain, Speculator, and Bertha properties, was active nearly half the year. The output consisted of 12,493 tons of copper ore shipped to Anaconda for direct smelting or for milling and 11,934 tons of zinc ore shipped to the flotation mill at Anaconda. The regular production of ore ceased in May, and the company went into the hands of a receiver in June; no shipments of ore were made after November. The mine is opened to a depth of 3,700 feet; practically no development was done in 1927.

The Otisco mine produced about 10,000 tons of silver-lead-zinc ore, which was treated at the custom milling plant at Butte. The mine, which is opened by a vertical shaft 400 feet deep, was operated under the control of the Clark-Montana Realty Co. late in the year and became a large producer of silver, lead, and zinc. Development in 1927 consisted of 1,468 feet of drifts, 485 feet of crosscuts, and 256 feet of raises.

At the Right Bower mine 300 feet of drifting was done, and more than 1,000 tons of sulphide copper ore of good grade was shipped to Anaconda for smelting.

The Agnes-Highland group in the outskirts of Butte was worked by the Ardsley Butte Mines Corporation. Work was started in March, and $111,025 was spent in development during the year. In November ore shipments were started at the rate of 70 tons a day, and more than 3,000 tons, chiefly siliceous silver ore, was shipped to Anaconda for smelting. The property is opened by a shaft 365 feet deep and 400 feet of drifts, and production was greatly increased early in 1928.

Lessees operating the Garfield-Salvador property shipped more than 1,000 tons of lead-zinc ore to the flotation plant of the Timber Butte Milling Co.

The Mountain Chief property produced only 102 tons of copper ore.

The Curry property, owned by the Anaconda Copper Mining Co., was operated by lessees who shipped nearly 1,000 tons of lead-zinc ore to the flotation plant of the Timber Butte Milling Co.

Other properties at Butte that produced more than 100 tons of ore each in 1927 were the Butte-Bullwhacker, Lavena, Ballaklava, and Seymour mines. Small shipments of ore were made from the Silent Treasure, Cripple, Minnie Jane, Brittania, Elba, Gold Stream, I. X. L., and Rose O'Malley claims.

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